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NEW AND NOTEWORTHY WESTERN PLANTS. III.[1]

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Phacelia acanthominthoides, n. sp.—An annual or biennial, 2 to 5^{dm} high or higher: stems many, profusely branched from the base, erect or reclining, cinereous: leaves at least in the mature plants all cauline, alternate, usually subtending the branches, those from near the base 10^{mm} long, pinnately 3 to 5-lobed or toward the apex only pinnatifid; the pubescent petiole almost equaling the blade proper; lobes hispidly strigose on both sides, 1^{cm} long or less, margins with few much-rounded teeth; upper leaves finer dissected and without petioles: inflorescence ample, in widely branched scirpoid racemes; flowers bluish, upon short pubescent pedicels: the 5 sepals pubescent, 4^{mm} long, 1.5^{mm} wide, linear-oblong, very obtuse, united at base, much exceeded by the flower: corolla 8^{mm} long; petals 5, very short, obovate, lateral nerves extending from the middle basal primary ones: stamens 5, exserted, inserted near the corolla base and alternating with the segments; anthers elliptic, 1^{mm} long, versatile; filaments glabrous, slender, 8 to 10^{mm} long, with minute hyaline appendages at base: ovary ellipsoid, pubescent; style persistent, 7^{mm} long, cleft nearly to the base, the united portion sparsely pubescent; stigmas minute, terminal: herbaceous sepals of the mature capsule 8^{mm} long, 4^{mm} across the widest part, ovate, acute, subcoriaceous, with ciliate margins, strongly 1-nerved with prominent reticulations: capsule 2-valved, sessile, 4-seeded: seeds dark brown 2.5^{mm} long, oblong, triangular, pitted.

[1] The first four new species have been in manuscript more than two years, and the types are in the herbarium of Stanford University.

Type specimen collected in May 1903, by Miss *Laura M. Lathrop* at Hernandez, San Benito County, California.

This species can be distinguished readily by its reticulately nerved, broadly ovate, and ciliate mature calyx lobes, not unlike the bracts of *Acanthomintha ilicifolia* Gray.

Trichostema rubisepalum, n. sp.—Erect annual, 2 to 3^{dm} high: stems chiefly branched from near the base, the branches usually in pairs and ascending, soft pilose and glandular, the lower ones becoming reddish: leaves cauline, opposite, entire, subsessile, linear-lanceolate, pilose on both sides and finely glandular, acute or acuminate, 2^{cm} long or longer, about 5^{mm} wide: inflorescence in axillary short-pedunculate cymes; flowers blue, solitary, on 2 or 3 glandular pubescent pedicels, subtended by linear bracts: calyx united below the middle, bristly pilose and somewhat glandular, about 6^{mm} long; the 5 subequal segments straight, acute, ultimately turning to a pink or light purple: corolla exceeding the calyx, 7^{mm} long, curved, pilose, throat oblique; its segments also pilose, thin, obscurely bilabiate; upper lip somewhat shorter and 2-segmented; lower one with 3 segments: anthers much exceeding the corolla, in two pairs of unequal lengths; filaments curved, equaling the tube, slender, glabrous, apparently adnate to the entire length of the thin corolla tube; anther cells united toward the apexonly, attached dorsally to the filament, ovoid, the base ultimately much spreading: style glabrous, filiform, recurved, equaling the shorter stamens and inserted in the depression of the ovary lobes; ovary short pubescent, deeply 4-lobed: seeds amphitropous.

Type specimen collected by Miss *Laura M. Lathrop* at Hernandez, San Benito County, California, August 1902.

This is closely related to *T. laxum* Gray, but distinguished by its long pilose and glandular pubescence, sessile or subsessile leaves, and by its usually pilose corolla. The tips of the sepals soon turn red.

Collinsia Hernandezii, n. sp.—Annual, 10 to 20^{cm} high: stems branched from the base, central ones erect, the outer reclining, soft yellowish pubescent, glandular: leaves cauline, opposite, oblong to oblanceolate, the larger ones 4^{cm} long, 1.5^{cm} wide, apex obtusely rounded, gradually tapering at the base to a 1^{cm} long pubescent petiole, margins entire, short and dirty glandular pubescent on both sides, rather thick, the 3 to 5 obscure nerves parallel; upper leaves

becoming bract-like: flowers large, widely scattered along the spicate racemes, half nodding upon short glandular pubescent peduncles, subtended by leaf-like bracts: the 5 distinct sepals glandular pubescent, 5^{mm} long, 1.5^{mm} wide at base, acuminate: corolla bluish, 2^{cm} long, strongly bilabiate, saccate at base, with gibbose throat; lower lip obscurely 3-lobed, the middle lobe longer and prominently conduplicate; upper lip ascending, shorter, and broadly bilobed: fertile stamens 4, equally inserted upon the tube near the base, longer pair 1.5^{cm} long, shorter pair 2^{mm} less, jointed and papillate at base; filaments winged, downwardly recurved, glabrous or the longer ones glandular above the middle; fifth stamen represented by an oblong membranous pouch on the lower portion of the corolla tube; anthers 2-celled, round or reniform, cells united at apex: ovary soft pubescent and finely glandular; style usually straight, thick, about equaling the stamens, sparsely glandular toward the base.

Type specimen collected by Miss *Laura M. Lathrop* at Hernandez, San Benito County, California, June 1903.

Its habit and pubescence is that of *C. Greenei* Gray, but the leaves and flowers are different.

Fritillaria succulenta, n. sp.—Stems glabrous, erect, simple, 2 to 3^{dm} high, from a bulb of fleshy scales: basal leaves ascending, 5 to 10^{cm} long, 2 to 3^{cm} wide, in pairs or in whorls of three, elliptic-oblong, obtuse, succulent and covered with a bloom; cauline ones few, erect, alternate or the lower in pairs, lanceolate, also fleshy and glaucous: flowers solitary or on the larger plants in racemes of three, nodding; peduncle subtended by a leaf-like bract, glabrous, 1 to 2^{cm} long: perianth campanulate, 2 to 3^{cm} long, wider than that when spreading; the 6 segments 2 to 3^{cm} long, obtuse, oblanceolate to obovate, glabrous beneath, purple, entire, margins at apex yellowish, numerously striate with darker purple and the upper surface pulverulent or obscurely crested: stamens 6, inserted upon the base of the segments, included; anthers 3 to 4^{mm} long, elliptic-oblong, versatile, extrorse; filaments 8^{mm} long, glabrous, more or less expanded toward the base: style 1^{cm} long, glabrous, cleft into three segments half way down, the recurved segments subcompressed and bearing terminal stigmas; ovary smooth, truncate at apex.

Type specimen collected in April 1903 by Miss *Laura M. Lathrop*, at Hernandez, San Benito County, California.

Its leaves are quite thick and fleshy, and are usually glaucous on both sides.

Sanicula serpentina, n. sp.—Low spreading biennial or perennial herb, from slender rootstocks, 2^{dm} high or less, wholly glabrous and frequently somewhat glaucous, a rich brown color when cured: stems chiefly branched from the base, the central one erect, the marginal ones ascending: leaves mostly from the base, subtending the branches, the radical ones upon membranously flattened 3-nerved petioles 2^{cm} long; blade proper 2^{cm} long or longer, ovate in outline, 3^{cm} across the base, pinnately divided into laciniate lobes which are again divided into slender acuminate usually somewhat recurved and sharply pointed segments: inflorescence branched from near the base, long-pedunculate; involucre of sessile leaf-like bracts; heads 3 to 5, the peduncles of the lateral heads usually much shorter at least when in flower, densely flowered, about 4^{mm} in diameter; involucels of entire lanceolate bracts slightly shorter than the yellow flowers; marginal flowers sterile, pedicelled, the fewer inner ones sessile and fertile: calyx 5-toothed: petals 1-nerved, quite broad across the middle, the setaceously acuminate apex strongly inflexed and emarginate on its bend: stamens incurved near the apex; anthers broadly elliptic, 0.5^{mm} long: ovary with uncinate prickles; styles 2, slender, recurved, each persistent from the inner face of the stylopodium: fruit not observed.

Type specimen no. 4498, collected in April 1903 near Portola, San Mateo County, California.

This form is nearest related to *S. laciniata* H. and A., but the latter is a much more rigid herb, with coarser, broader, spinosely toothed leaf divisions; and with the bracts of the involucels often 3-parted or at least 3-nerved from near the middle. It was discovered on serpentine rocks near Searsville Lake, of the chaparral formation.

Trifolium bicephalum, n. sp.—More or less tufted, from an annual root: stems slender, 8 to 18^{cm} long, decumbent or the outer ones prostrate, rather numerous from the base, rarely branched, sparsely pubescent: leaves both radical and cauline, the basal ones somewhat smaller and more numerous, with slender flexuous pubescent petioles 2^{cm} in length; stipules adnate, 6^{mm} long, membranous, strongly nerved, subglabrous or finely ciliate along the edges, terminated by two setae 2^{mm} long; leaflets 7^{mm} long, 4^{mm} wide, soft pubes-

cent with brownish hairs, obovate or truncate and usually emarginate, entire or obscurely dentate above the middle, with prominent ascending nerves beneath: peduncles pubescent, equaling half the length of the stem or branch, subflexuose above the middle; bicephalous heads terminal, sessile, unequal in size, each subtended by a subsessile trifoliate leaf with broad ovate stipules; involucre none: calyx densely pubescent, 4^{mm} long including the 2^{mm} sharply acuminate teeth: corolla exceeding the calyx teeth by 1 or 2^{mm}, hyaline and united with a stamineal tube below the middle; upper lip whitish, obovately rounded and surrounding the lateral lobes or wings; lateral lobes oblongish, slightly shorter than the banner, obtuse or acute apical portion nearly white, the middle portion purple, the basal portion hyaline and with an auricle; keel obtuse, shorter than the wings, purplish: anthers very small: ovary glabrous, 2-ovulate; style glabrous, equaling the stamens, terminally recurved, bearing a capitate stigma.

Type specimen no. 4812, collected at San Pedro, San Mateo County, California, May 1903.

This species comes nearest to the so-called Californian *T. Macraei* H. and A., but is a much smaller and more prostrate clover, with leaves distinctly obovate and emarginate. It forms dense prostrate mats on a high promontory near the sea.

Eriophyllum Greenei, n. sp.—A cespitose perennial, from a woody base: stems many from the crown, lanate, branched above the middle: leaves numerous on the sterile stem, the lower ones opposite, the upper ones alternate, petiolate, triangularly ovate in outline, 2 to 3-pinnately divided, lanose on both sides; the segments short, blunt, very narrow, with incurved margins inclosing a dense matrix of woolly hairs; petiole about equaling the blade, as broad as the segments with edges incurved: heads heterogamous, solitary, terminating the leafy branches, ovoid, 1^{cm} broad; peduncle white tomentose, without bracts; involucre quite rigid, cup-shaped, densely lanate, united at base; bracts in one series, acute, 10^{mm} in length: ray flowers light yellow, 15^{mm} long including the achene, pistillate; tube 2^{mm} long, pubescent, ligule 8^{mm} long, 3^{mm} wide, obovate or oblanceolate, many-nerved, apex obscurely 3-toothed: style arms 1^{mm} long, narrowly flattened, obtuse: receptacle obscurely pitted, somewhat raised and subconic: disk flowers perfect, very numerous,

6^{cm} long with the achenes: tubular corolla yellow, sparsely pubescent, terminated by 5 obtuse segments: anthers 1.5^{mm} long, with apex triangularly ovate, bases obscurely auriculate; filaments barely as long, inserted upon the middle of the tube: style arms flattened, bearing small capitate stigmas: achene brownish black, 3^{mm} long, usually curved and attenuate from the base, subcompressed or 4-angled, edges ciliate: pappus persistent, less than 1^{mm} in length, of unequal paleae.

Type specimen no. 4335, collected in the Mocho Creek Canyon, Alameda County, California, May 1903.

It is intermediate between *E. arachnoideum* Greene and *E. caespitosum* Dougl., but sufficiently distinct from either. Named for Professor E. L. GREENE.

Navarretia Abramsi, n. sp.—Densely lanose herbs, about 6^{cm} high: stems solitary or several from the base, rigidly erect, chiefly branched from the middle; branches rather stout and straight, ascending, terminated by solitary comparatively large heads: leaves mostly subtending the heads, the larger ones 2^{cm} long, 1 or 2-laciniately divided, soon becoming dry and brittle; the lobes very narrow, becoming glabrous, usually recurved and terminated by a fine sharp point: heads turbinate, the larger ones 1^{cm} across at top, densely surrounded by a matrix of lanate hairs, 6 to 10-flowered, the subtending bracts similar to the leaves but smaller: corolla easily separating from the base, 8^{mm} long including the 3^{mm} long segments, bluish or nearly white, glabrous, hyaline, conspicuously nerved; segments 5, subequally divided, linear spatulate, entire or finely dentate at apex: stamens 5, barely exceeding the throat of the corolla, subequal in length, filaments threadlike, subequally inserted upon the tube 2^{mm} below the throat; anthers ovate or elliptic, 1^{mm} long, apex obtuse, base sagittate: style persistent, glabrous, minutely lobed at apex: calyx of the mature capsule 6^{mm} long, divided nearly to the base; the sepals straight and erect, linear, hyaline below the middle, held intact by the hairy matrix; the upper part of the sepals glabrous, foliaceous, and acuminately pointed: capsule triangular, when mature easily falling out from the persistent calyx, straw-colored, smooth and shining, 4^{mm} long, 1.5^{mm} in diameter, apex pointed, 3-celled, loculicidally dehiscent: seeds solitary in each cell, subterete, 3^{mm} long, brown and very hard, with a gelatinous cover which readily dissolves in water.

Type specimen no. 4586, collected on Black Mountain, Santa Clara County, California, July 1905.

It is a very late summer-flowering annual, chiefly confined to dry gravelly soil immediately bordering thickets of the Californian chamiso (*Adenostoma fasciculatum* H. and A.). Named for Mr. L. R. ABRAMS, a former student of botany and classmate at Stanford University.

Ribes Stanfordii, n. sp.—A rigidly branched shrub, 1 to 1.5^{m} high, nearly as broad: bark on the younger branches light brown, becoming grayish white with age, thin, separating into shreds; branchlets subtended and protected by 3 spines, very short and rigid; spines about 1^{cm} long, straight, shining brown, divaricate, distinct, the middle ones usually longer, exceeding the axillary leafy branchlets; branchlets terminated by 1 to 3 small tufts of leaves, subtended by diminutive spines, each tuft provided with a subwhorl of 3 to 5 leaves and terminated by a small inflorescence of 1 to 3 flowers: leaves orbicular, 8^{mm} long including the finely glandular pubescent 2 to 3^{mm} long petiole, deeply cleft into 3 segments, soft pubescent on both sides, rather thick, the segments usually terminated by subequal obtusely rounded teeth or lobes, obscurely 3 to 5-nerved; petiole gradually expanded at base into the adnate stipules: flowers 3, upon a short and pubescent peduncle, each separately inserted and sessile, subtended by conspicuously broad pubescent bracts: calyx about the ovary densely pubescent, 3^{mm} in diameter, its tube 2^{mm} in diameter, less pubescent, about 2^{mm} long, the 5 segments exceeding the corolla by 1^{mm}, triangularly obtuse, puberulous on the outer surface, 2^{mm} long, yellow, rotate or much reflexed: corolla deeper yellow, inserted upon the calyx throat and alternating with the segments, straight, obovate, 2^{mm} long: anthers 5, inserted upon the calyx throat and opposite the segments, equaling the corolla; filaments glabrous, flattened, 1.5^{mm} long: style erect, subterete, slightly exceeding the stamens: anthers ovate, obtuse at apex, light yellow, truncate or only obscurely lobed at base, 1.5^{mm} long, 1^{mm} wide at the base: berry yellow and pubescent at least when young.

Type specimen no. 3958, collected on Mt. Pinos near Griffin's Postoffice, Ventura County, California, July 1902.

It was discovered in open pine regions in the vicinity of cliffs and rocky outcroppings at the summit. Not common. Distributed as *R. nubigenum* McClatch.

Pedicularis Dudleyi, n. sp.—Perennial herbs, 2 to 3^{dm} high, usually from a branched caudex: stems solitary from each of the scaly crowned caudices, the central ones erect, the outer ones ascending, simple or sometimes branched, not exceeding the basal leaves, lanose especially toward the base, more or less curved; basal bracts brown, lanceolate, entire, glabrous, marcescent: leaves chiefly from the base of the stem, alternate, the uppermost at about the middle of the stem but not exceeding it, the lowest ones longest and somewhat decumbent, lanceolate in outline, the larger 25^{cm} long, 6^{cm} wide; leaf segments about 10 pairs, subglabrous or short pubescent on the nerves, membranous; lower pairs distinctly petiolate, the upper pairs not only sessile but broadly united, those along the middle largest; each lobe ovate or oblong in outline, 3^{cm} long, 2^{cm} wide, cleft into irregular lobes or merely dentate, the margins unequally serrate or dentate, its teeth sharply pointed: inflorescence spicate, densely flowered, at most 5^{cm} long and 3^{cm} in diameter, upon peduncles equaling half the length of the stem, usually erect but frequently somewhat curved; bracts subtending the flowers, foliaceous, serrately toothed, the upper ones equaling the flowers, the lower ones much exceeding them: calyx 1^{cm} long, unequally 5-cleft, the segments acute and obscurely toothed toward the apex, densely lanose on the exterior: corolla 2^{cm} long, the narrow tubular part half that in length, glabrous; upper lip conduplicate, slightly notched at apex, pink or whitish, much protruding and arched; lower lip subequally 3-toothed: stamens equal; filaments glabrous; anthers broadly elliptic, attached to the basal dorsal side, the cells connate and rounded at apex, the base not united, acute: style filiform, subpersistent, thicker and more or less flattened toward the apex, conspicuously recurved and protruding from the upper lip; ovary glabrous, dark brown, 2-celled, flattened, acuminately pointed: capsule coriaceous, 12^{mm} long, 7^{mm} wide, acuminately terminating in an upwardly curved point: seeds about 4, black when mature, pitted, subterete or obscurely angular.

Good flower and fruit of this type specimen, no. 4289, was collected in May and June 1903, at Iverson's Ranch on the Pescadero Creek, San Mateo County, California.

Only known from this locality, where it is rare and confined to the deep shade of *Sequoia sempervirens*. Its proximity to a camping ground endangers its exist-

ence. This denizen of the Santa Cruz Mountain redwoods is named in honor of Professor W. R. DUDLEY of Stanford University, who first discovered it.

Orthocarpus longispicatus, n. sp.—A profusely branched decumbent biennial or perennial, forming rather dense mats: stems slender; elongated and distantly branched, often 1^{m} in length, usually pubescent with soft glistening white hairs: leaves alternate, evenly scattered, sessile, membranous, puberulent on both sides, or with glistening hairs on the margins and along the 3 obscure nerves, cleft into 2 pairs of strap-like segments, the middle one longest: inflorescence spicate, very long and usually curved; bracts not exceeding the flowers, 5 to 7-laciniately cleft, the obtuse apices light red: calyx 4-cleft, soft pubescent, equaling the corolla, with colored tips: tube of the corolla 2^{cm} long, externally pubescent, gradually expanded from the constriction above the ovary; upper lip 1^{mm} longer than the lower one, rather straight, apex obtuse, finely pubescent on the lower surface, margins soft and hyaline; lower lip with 3 obtuse finely pubescent teeth which bear moderate sized sacs: stamens 4, inserted upon the middle of the corolla tube, the lateral pair shorter, the upper pair nearly equaling the galea and enclosed by it; filaments hyaline, linear-flattened, glabrous; the upper anther cell usually somewhat longer and shedding its pollen before the lower one: style persistent, glabrous, much exserted, thickened or expanded toward the base of the capitate flattened or obscurely lobed stigma; ovary oblong, truncate at the apex: capsule 10^{mm} long, smooth, loculicidal: seeds numerous, lenticular, with broad reticulate wings.

Type specimen no. 4938, collected in July 1903, at Point Reyes, Marin County, California.

It was quite abundant among the pickle weed (*Salicornia ambigua* Michx.), along edges of brackish water. Distinguished by its long decumbent fragile stems and branches, numerous leaves, and elongated densely flowered spikes.

Godetia lanata, n. sp.—Erect annual, 3 to 6^{dm} high, single or branched from near the base, quite rigid; mature stems shining, straw-colored, scaling at base into membranous shreds, with ascending branches from or above the middle; the younger branches yellowish tomentose: leaves cauline, lower ones soon falling, alternate and clustered, sessile, very unequal, cinereous on both sides, semicoriaceous, lanceolate or linear-oblong, equally tapering at both ends, acute, the larger ones 5^{cm} long, 15^{mm} wide, midnerve quite promi-

nent beneath, lateral ones obscure: inflorescence short, spicate or subcapitate, terminating the branches, usually densely flowered, 3 or 4^{cm} in diameter; buds erect, from the terminal central axis; flowers easily separating from the ovary, subtended by strigose lanceolate acuminate bracts, subsessile: calyx tube obconic, 3 to 4^{mm} long, lanose pubescent; its 5 equally pubescent segments 12^{mm} long, acuminate and ultimately reflexed: corolla and stamens inserted upon the rim of the calyx throat; petals straight, thin, pink, broadly obovate in outline, 6^{mm} long and wide, irregularly or obscurely 3-toothed, the middle tooth acute, usually the larger: stamens 8, in 2 series, those alternating with the petals nearly equaling them, those opposite the petals barely more than 1^{mm} long; filaments glabrous, compressed, broadest at the base; anthers introrse, basifixed, those of the upper series twice as long as those of the lower: style glabrous or with a few long hairs, barely equaling the stamens, bearing an obscurely 4-lobed stigma; ovary densely and persistently lanose pubescent, upon short thick pedicels: capsules subtended by leaf-like bracts longer than themselves, loculicidally dehiscent from the apex, straight, erect, lanose, subsessile, apex truncate, nearly of the same thickness throughout, subterete or only slightly 4-sided, 8-costate, 4-celled, 4-valved: seeds numerous, in single rows, dark brown, subterete or cubical, a little pointed at one end.

Type specimen no. 4376, collected in June 1903 at Bardins railroad switch, Monterey County, California.

This characteristic species was found quite plentiful on the sandy plain between Monterey and Castroville, and is quite variable in the density of its pubescence branching habit, and size of leaves.

Pentachaeta laxa, n. sp.—A lax very much branched annual, 1 to 2 or 3^{dm} high: stems branched from the base, softly but sparsely pilose: leaves in pairs, subtending the branches, sessile, linear, gradually tapering from the base, the larger ones 3^{cm} long, 2^{mm} wide, very thin, sparsely pilose on both surfaces: heads terminal, heterogamous, turbinate, 6^{mm} long, about 9-flowered; the peduncle ascending, 1 to 4^{cm} long, pilose, somewhat thickened toward the apex; involucral bracts 3 to 5, persistent, flat, acute, oblong, scantily pilose on the exterior, the reticulate nerves quite prominent, equaling the flowers, more or less membranous: receptacle pitted: each of the ray flowers

subtended by an involucral bract, yellow, caducous, pistillate, tube 1^{mm} long, bearing a broad 1^{mm} long notched ligule: style arms exceeding the ligule, recurved, acute: disk flowers perfect, tubular, light yellow and caducous, 2^{mm} long, the upper half inflated, bearing 4 obtuse teeth: anthers well included, 0.5^{mm} long, rather broad, bases truncate, each with a very prominent apical appendage; filaments thread-like, scarcely longer than the anther: style barely exceeding the corolla, its arms subcompressed, recurved, short, obtuse or truncate at apex: achenes subterete, 5^{mm} long, black when mature, finely rugose, dotted with sessile yellowish brown glands subtended by short setae; pappus of 2 or 3 paleaceous scabrous awns, usually persistent.

Type specimen no. 4437, collected in May 1903, on Cedar Mountain of the Mount Hamilton Range, Alameda County, California.

This distinct species inhabits a steep shaded ravine of fertile soil, and forms a tangled mass with its numerous decumbent branches. Not observed elsewhere, and evidently very rare.

Nemophila Fremontii, n. sp.—Delicate annual: stems procumbent or prostrate, branched, subglabrous or sparsely retrorsely pubescent, 10 to 30^{cm} in length: radical leaves similar to the lower cauline ones, frequently forming a rosette, 3^{cm} long including the 1.5^{cm} long strigose petiole; blade membranous, ovate or oblong in outline, usually oddly pinnate with two pairs of nearly divided lobes or the uppermost merely sinuate, sparsely pubescent on both sides, paler beneath; the lobes nearly as broad as long, rounded, finely mucronate: flowers solitary, upon slender flexuose usually recurved 2^{cm} long peduncles which are clothed with retrorse bristles: calyx persistent, campanulate, 3^{mm} long, the basal one-third united, equaling or exceeding the corolla, pubescent with fine bristle-like hairs; sepals oblong, obtuse or acutish, foliaceous, with a short blunt recurved appendage from each sinus: corolla white, urn-shaped, its lobes becoming reflexed, at most 3^{mm} long, 5-cleft, the basal appendages quite obsolete; petals hyaline, ovate to oblong or obovate, obtuse, sparsely ciliate on the edges above the middle: anthers 5, alternate with the petals, erect, quite a little shorter than the corolla; filaments inserted half way down on the corolla tube, glabrous, 1^{mm} in length; anthers 0.3^{mm} long, comparatively broad, apex obtuse,

base subcordate: ovary sessile, densely pubescent: style 1^{mm} long, cleft into 2 recurved arms, terete, glabrous, persistent; stigma terminal, capitate: capsule 4^{mm} in diameter, globular, sparsely ciliate: seeds compressed, carunculate.

Type specimen no. 4901, collected in May 1903, on Fremont's Peak of the Gabilan mountains, San Benito County, California.

It was observed only at the very summit of the peak, among the moss-covered rocks.

Monardella franciscana, n. sp.—A sprawling suffrutescent perennial: lower stems reclining on the ground or in dense herbaceous thickets, woody, one or more meters long; the leaf-bearing upper stems usually clustered, herbaceous, woolly pubescent, 2 to 3^{dm} long, erect or decumbent near the base: leaves opposite, mostly fascicled, very variable in size, densely woolly pubescent on both sides especially beneath; the larger upper ones 2 to 3^{cm} long including the 5^{mm} long petiole, 2^{cm} wide near the base, broadly ovate, entire or with a few obscure teeth, the edges recurved; the lower or axillary ones sessile, lanceolate to elliptic-obovate: inflorescence capitate; heads densely flowered, terminal, rarely more than one, 3 to 4^{cm} in diameter, subtended by a whorl of pubescent leaf-like bracts equaling or exceeding the flowers; flowers upon stout short pedicels: calyx about 8^{mm} long, the marginal ones usually curved upward, conspicuously 11 to 15-nerved, silky pubescent except near the base, tubular, equally 5-toothed; the teeth acute, 1.5^{mm} in length: corolla blue or light pink, funnel-shaped, the longest 2^{cm}, strigose about the middle, glabrous toward the base, bilabiate; upper lip 5^{mm} long, erect or straight, apex 2-lobed; lower lip divided into 3 linear segments, equaling the upper lip, usually deflexed: stamens 4, fertile, moderately unequal, exserted and spreading; filaments slender, glabrous, inserted at the corolla throat or a trifle beneath it; anthers attached to the base, the cells somewhat recurved: style equaling the stamens, glabrous; stigma minute, terminal; ovary glabrous, distinctly 4-lobed.

Type specimen no. 4766, collected at San Pedro, San Mateo County, California, July 1903.

It was repeatedly observed in dense herbaceous growths in the ravines on the coast from San Francisco to Santa Cruz, and is a distinct seacoast species.

HORKELIA BOLANDERI **marinensis**, n. var.—Tufted perennial, 1 to 2^{dm} high, villous pubescent: stems deflexed and more or less decumbent: leaves pinnately divided into 5 to 8 pairs of leaflets, subradical though often the stem bears as many as 3 to 5 leaves without subtending branches; average leaflets 10^{mm} long, unequally 4 to 10-toothed; basal stipules narrowly linear, 10^{mm} long, those on the stem broader and usually 1 or more-toothed: inflorescence branched from near the middle, corymbosely paniculate; branchlets loosely flowered: hypanthium longer than wide, saucer-shaped; bracts broad, 3-toothed: stamens 10, opposite the outer and inner series of sepals which must exceed them: outer sepals shorter, spatulate or acute at apex, pubescent on both sides; inner ones acuminately triangular, glabrous on the inner surface: filaments glabrous, flattened, slightly unequal in length; anthers introrse, short, elliptic: petals white, narrowly spatulate or oblanceolate, about equaling the sepals, early falling: styles many, glabrous, erect: seeds bean-shaped, smooth.

Type specimen no. 5039, collected in sandy soil at Point Reyes, Marin County, California, July 1903.

This variety has been distributed as *H. Parryi* (Wats.) Ryd. It has the pubescence of typical *H. Bolanderi* Gray, but the stems are more or less decumbent, basal stipules strictly linear and almost twice as long as in the species, leaflets larger and more toothed, and inflorescence more loosely corymbose and with larger hypanthia.

Chrysopsis arenaria, n. sp.—A wiry perennial herb, from creeping and much branched roots: stems 10^{cm} long or very much shortened and bearing a dense rosette of leaves, erect or more often subreclining, hirsute: basal leaves soon withering; cauline ones many, ascending, obovate to oblanceolate, the lower ones slenderly attenuate from the base, alternate, entire, hispidly hirsute on both sides, ascending: heads heterogamous, terminating the stems, 1 to 3, barely exceeding the leaves, upon densely hirsute often glandular and few-bracteolate peduncles, 15^{mm} in diameter, nearly that in length; involucre of several series, campanulate; bracts linear, imbricate, acuminate, pubescent, the longer ones 10^{mm} in length and usually with pink scarious margins: receptacle flat, favose: ray flowers in one series, pistillate, showy; ligule yellow, 4-nerved, narrowly oblanceolate, entire, 6^{mm} long; its tube slender, 5^{mm} long, glab-

rous, expanded at base: style barely exceeding the throat, with short appendages: disk flowers many, all tubular, equaling the pappus, perfect, terminated by 5 acute teeth, 6^{mm} in length, expanded at the base, yellow: anthers included, 2^{mm} long, bases obscurely auricled, apex triangular, acute; filaments glabrous, inserted upon the tube one-third from the base: style much exceeding the tube, its arms flattened, short and truncate: achenes compressed, silky pubescent: pappus bristle-like, chiefly of two series, rusty or yellowish white, the longer series 5^{mm} in length, finely scabrous, the basal one very short, lighter colored, smooth.

Type specimen no. 4556, collected at Point Reyes, Marin County, California, July 1903.

It forms dense prostrate mats on the windward side of the drifting sand dunes.

Castilleia Wightii, n. sp.—A tufted perennial herb, 3^{dm} to 1^{m} tall: stems several from the crown of the root, much branched from the base to the middle, glandular pubescent with dirty yellowish hairs: leaves alternate, sessile, quite membranous, pulverulent on both surfaces, or sparsely hairy along the 3 nerves, broadly linear to oblong, the larger ones 6^{cm} long and 15^{mm} wide, mostly with one pair of linear lateral segments from the middle of the leaf, the terminal lobe much longer and wider: inflorescence spicate, 10 to 20^{cm} long, terminating the erect corymbosely disposed branches; subtending bracts barely equaling the flower, densely covered with glistening subglandular hairs, 3-nerved and 3-cleft, the upper ones with colored tips: calyx pubescent, laterally compressed and equally cleft nearly to the middle, the halves 2-toothed, subequaling the corolla: tube of corolla proper 10^{mm} long, glabrous, saccate, its nerves prominent; galea or upper lip longer than the tube, quite broad and membranous at base, straight, its blunt apex rather thickened and retrorsely pubescent on the outer surface; lower lip 3-toothed, teeth 1^{mm} long, obtuse, all alike: stamens equally inserted upon the middle of the corolla tube, the lateral pair a trifle shorter, the upper pair nearly equaling the galea and enclosed by it; filaments glabrous, flattened, with hyaline margins; anther cells broadest at base, subequally attached: style little protruding, flattened, glabrous, persistent, often recurved near the apex, bearing a capitate or obscurely flattened stigma; ovary smooth, somewhat compressed, acute toward the apex: cap-

sule 12^{mm} long, ovoid, sharply pointed, coriaceous, loculicidal: seeds many, orbicularly compressed or somewhat elongated, with reticulate wings.

Type specimen no. 4761, collected on the trail between Spring Valley Lake and San Pedro, San Mateo County, California, July 1903.

It is a uniquely distinct subglandular species easily recognized by its abundant foliage, densely flowered elongated spikes, and broadly linear unequally 3-segmented leaves. Named for W. F. WIGHT, a former student of botany and classmate at Stanford University.

Phacelia flaccida, n. sp.—Delicate annual, 3 to 6^{dm} high: stems sparingly but widely branched from the middle, rather weak and more or less reclining, rarely erect, beset with stinging white hairs: leaves few, alternate, usually subtending the branches, the larger ones 5^{cm} wide and 7^{cm} long, ovate to elliptic in outline, very thin and flaccid, only sparsely setigerous on both surfaces, 3 to 5-pinnately nerved, obscurely lobulate, the margins with irregular low roundly obtuse teeth, base rounded or obscurely and unequally subcordate; longer petioles 4^{cm} in length, setose, the younger ones cinereously pubescent: inflorescence usually dichotomously branched; flowers secund, not crowded, upon short ciliate pedicels: calyx of 5 persistent herbaceous distinct segments, the 4 smaller ones oblanceolate and in the mature state 7^{mm} long, bristly ciliate: corolla barely exceeding the calyx, 3^{mm} long, blue or pale white; the 5 segments short-ovate and comparatively very broad: stamens well included within the tube, alternating with the segments and inserted near the base of the tube; anthers short-elliptic, versatile; filaments nearly equal, glabrous, usually curved above the middle, subtended by small hyaline entire membranous folds: ovary persistent, pubescent; style persistent, equaling the anthers, cleft almost to the base, each division bearing a minute terminal stigma: capsule ovoid, 1-celled, divided into 2 valves, 1-seeded in each; seeds brown, flattened, 2^{mm} long, obscurely pitted.

Type specimen no. 4404, collected at Wright's Station, Santa Clara County, California, June 1903.

This delicate species was discovered in a damp deeply shaded nook on the banks of Los Gatos Creek. Otherwise not known.

Leptosyne Hamiltonii, n. sp.—Glabrous acaulescent annual: leaves tufted, all radical, mostly erect, rather thick, 2 to 3^{cm} long

including the 1 to 2^{cm} long flattened petiole; blade proper triangular-ovate in outline, 1^{cm} long, fully as wide at base, 2 to 3-pinnately divided; the segments not wider than the petiole and the rachis, 1^{mm} wide, ultimate ones short, with bluntly rounded apices: scapes usually 1 to 3 from each root, glabrous, 10 to 18^{cm} long, slender, usually somewhat curved, each bearing an erect solitary head; heterogamous heads subcampanulate or cup-shaped, 1^{cm} in diameter, a trifle less than 1^{cm} in height; involucre glabrous, truncate and united at the base, in two series; bracts of lower series 5, thickish, linear, obtuse, 4^{mm} long, dark brown; inner series of 8 to 10 striate bracts, shining, yellowish, about 10^{mm} long, 4^{mm} wide, submembranous, oblong, acute: ray flowers about a dozen or more, pistillate and fertile; tube 1.5^{mm} long, subglabrous; branches of stigma barely exserted, recurved; ligule 3 to 4^{mm} wide, 6^{mm} long, elliptic to oblong or obovate, apex round, usually with a short obtuse tooth: scales equaling the flowers, subpersistent, linear, hyaline, obtuse, 3-nerved, those of the central flowers narrower: central flowers crowded, perfect, sterile, tubular; tube 4^{mm} long, hyaline, cylindric, the upper half subinflated, its 5 teeth obtuse and more or less thickened along the margins: anthers linear, 2^{mm} long, truncate at base, apex triangularly appendaged: style equaling the stamens, its 2 branches short, obtuse, and flattened; achenes linear-obovoid, compressed, marginally winged, ciliate on the edges, pubescent on the sides, brown and glabrous when mature: pappus of 2 caducous hyaline finely ciliate membranes.

Type specimen no. 2328, collected on Mt. Hamilton, Santa Clara County, California, April 1900.

It was in fine flower and fruit, and grew in dry gravelly soil on a steep slope a few hundred yards below the observatory. Since then I have failed to find it either in this same place or elsewhere.

EUNANUS ANDROSACEUS Curran.

This southern species was originally discovered at Tehachapi, California. From the middle western part of the state it is only known at Ben Lomond, Santa Cruz County, where fruiting specimens were collected by Mrs. *K. Brandegee* in April 1890. In July 1903 the writer found excellent flowering specimens in the same locality, which were distributed under no. 4519. It is evidently rare and prefers hot and dry gravelly soil of the chaparral formation. The plants were from 1 to 10^{cm} high, with single or branched stems, glandularly pubescent or the

older ones subglabrous: leaves sessile, obovate or linear-oblong, entire or obscurely apiculate above the middle, apex obtuse, attenuate toward the base, 5 to 20^{mm} long, the larger ones 5^{mm} wide: pedicels of solitary axillary flowers not exceeding 5^{mm} in length: calyx 8^{mm} long, compressed, somewhat inflated below the middle; the two upper parallel lobes a trifle longer than the lower and lateral ones, with 5 short and obtuse teeth: crimson corolla little exceeding the calyx, slenderly tubular, conspicuously constricted below the limb, pubescent on the exterior; limb barely bilabiate, the broadly rounded segments rotately spreading: stamens 4, all anther-bearing; filaments slender, inserted upon the corolla at the middle; anthers 0.5^{mm} long, comparatively broad, widely spreading: style glabrous, erect, bearing flattened lobed stigmas; ovary smooth, conically elongated.

LUPINUS POLYPHYLLUS Lindl.

This magnificent seacoast lupine was found as far south as San Pedro, San Mateo County, California, May 1903. At this station it grew in wet adobe soil, reached a height of 2^{m}, and is succulent and apparently an annual. The larger leaves were of an enormous size, and some of the flowering spikes exceeded the length of a man's arm. Flowers large, dense, with blue wings and purplish banner. Pods persistent, densely covered with soft long yellowish-white hairs. Distributed under no. 4444.

CAMPANULA EXIGUA Rattan.

No. 4357 was collected in May 1903 along La Puerta Creek, Stanislaus County, California. It was found on a dry mountain side composed chiefly of small rocks, and on gravelly embankments of the creek. At first it reminded me of a Gilia in growth and habitat. The flowers are large and showy: corolla bluish white, at first appearing tubular, ultimately campanulate: styles wholly included, bearing 3 revolute stigmas; dilated bases of the filaments not ciliate; capsule dehiscing regularly on the sides, 3-celled; seeds numerous, 0.75^{mm} long, half as wide, compressed, shining light brown, inserted upon 3 conspicuously enlarged placentae centrally attached to the main axis.

SALIX BREWERI Bebb.

The type of this willow was collected by W. H. BREWER on San Carlos Mountains of middle California, and described in Bot. Calif. **2**:88. 1880. Since then it has been reported from only a few localities. In May 1903, while making a botanical trip from Livermore, California, through San Antonio and Adobe valleys, I found it in fine fruit, and distributed it under no. 4648. It is quite abundant along the Little Colorado, Sweet Water Creek, and on the headwaters of the La Puerta, all of which rise on Red Mountain, Santa Clara County, California. This species was at once distinguished from the other willows, and bears a remarkable similarity to *Salvia mellifera* Greene.

It is a shrub 1 to 2^{m} high, rather gracefully branched from near the base;

branchlets sparsely branched, erect, about as tough as the western leatherwood (*Dirca occidentalis* Gray), cinereous pubescent: leaves terminally clustered, subsessile, linear to oblanceolate, acute, the larger ones 6^{cm} in length and 10^{mm} in width, densely canescent beneath, upper surface green and becoming glabrous except the sunken cinereous midnerve, margins entire or sometimes remotely apiculate: fruiting spikes immediately beneath the foliage, the short peduncle subtended by 3 foliaceous bracts, curved and slenderly elongated, 5 to 7^{cm} long, 10^{mm} in diameter, densely flowered: capsules short-canescent all over, 5^{mm} long including the very short pedicel, conspicuously compressed, lateral face ovoid, acuminate; styles persistent, not longer than 1^{mm}, 2-cleft, each segment again divided into recurved lobes: bracts spatulate or obovate, long ciliate pubescent; axillary gland persistent, quite prominent and cinereous.

CUPRESSUS GOVENIANA Gord.

About sixteen miles southeast of Livermore, Alameda County, California, is a mountain commonly known as Cedar Mountain. While collecting on this mountain during the latter part of May 1903, I did not find any true cedars, but found near the round-topped summit quite an area densely covered with a species of cypress. It was too late for staminate flowers, but an abundance of mature cones was collected. The trees are mostly of a young generation, of all sizes from 3^{dm} to 5^{m} high and cone-bearing, widely branched from near the ground, the terminal portion of the stem much exceeding the shortest uppermost branches; leaf branchlets slender, more or less spreading: leaves without conspicuous dorsal pits, acute, shining green: cones globose, 13^{mm} in diameter; the 8 unequally sized scales grayish-white on the outside, almost smooth or only with low umbos: seeds angular, prominently margined or winged along the lateral edges above the middle, reddish-brown and frequently somewhat glaucous, with a resiniferous odor.

This species was distributed under no. 4487. There is some doubt as to this determination, and its relationship to the other closely allied species is not as yet clearly understood. These flourishing trees might have been planted at some very early date.

MUHLENBERGIA DEBILIS Trin.

The distribution of this handsomely tufted grass is given from Texas to southern California. In May 1902 the writer found it in abundance on a dry gravelly hillside near Santa Barbara, California. In June 1903 a few dwarfed specimens were discovered on a cliff at Carmel Bay. The latter locality is its most northern known limit along the coast.

GOVERNMENT LABORATORIES,
Manila, P. I.

SOME LITTORAL SPERMATOPHYTES OF THE NAPLES REGION.

J. Y. Bergen.

The strand flora about the Bay of Naples differs so much from most of those which have been studied with reference to the toxic effect of sodium chlorid solutions that it seemed to the writer worth while to investigate the conditions of existence of a characteristic association.

Along a strip of beach sand not quite two meters above the average sea level and less than ten meters from the water line, on the margin of the Bay of Baiae, a well defined association of somewhat more than fourteen members was found. All of these occurred within a distance of a hundred meters, measured along the shore. The species determined were:

Euphorbia Paralias, E. terracina, Polygonum maritimum, Matthiola sinuata, *Alyssum maritimum, Plantago Coronopus, Medicago marina, M. litoralis, *Lotus ornithopodioides, Eryngium maritimum, Echinophora spinosa, *Senecio vulgaris, *Artemisia variabilis, *Inula viscosa.

I shall refer to this group as Association A. Other species occur as members of the association, but none could be identified with certainty at the time when these studies were made (January, February, and March). The five species designated by asterisks are much more abundant in inland stations than they are as strand plants. Conspicuous members of other strand associations neighboring the one above given are: *Narcissus Tazzetta* var., *Thymelaea hirsuta*, *Glaucium flavum*, and *Verbascum sinuatum*. Out of the fourteen listed above, *Euphorbia Paralias*, *Polygonum maritimum*, *Eryngium maritimum*, and *Echinophora spinosa* are the most notably psammophilous species. All four of these are capable of growing out of drifting sand, emerging again and again as they are partially buried.

Only a few of the structural peculiarities of halophytes, as enumerated by Warming,[1] were to be noted in the association under discussion. Studies carried through a considerable part of the year

[1] Oekologische Pflanzengeographie. Zweite Auflage. Berlin. 1902. pp. 305–308.

would be necessary in order to enable one to make a detailed comparison between plants of the same species found growing as members of this strand flora and further inland. The points that could be established during the months of late winter and early spring when these observations were made were as follows:

Alyssum maritimum (littoral form): leaves with more, longer, and stouter hairs on both surfaces than occur on the ordinary form; leaves much smaller and darker green than in the ordinary form; leaves from 1.5 to 3.5 times as thick as in the ordinary form.

Senecio vulgaris (littoral form): plants very low, often with the leaves in rosette form and heads in full bloom only 2^{cm} high. The maximum height observed was 8^{cm}, while the average height of plants growing in fairly good soil further inland was (ten specimens taken at random) 35.7^{cm}. The stems of the littoral form were proportionately stouter and more hairy, and the leaves were darker green, more pubescent, thicker, more sessile (sometimes clasping and almost decurrent). The root system of plants of the littoral form is much more developed than in the ordinary form, but there are no aerial roots, such as are commonly found along the lower part of the stems of this Senecio when growing in ordinary situations.

Artemisia variabilis (littoral form): leaves with more slender divisions, the tips more strongly mucronate and the surface more scaly than the ordinary form; the young leaves of littoral plants were often densely pubescent, while I have never seen them so on plants growing in ordinary stations.

No decided differences were noted between the specimens of Inula found growing in the beach sands and those occurring elsewhere. The Lotus plants were too young to be compared with inland specimens.

The beach sand in which Association A was growing consisted of grains for the most part ranging from 0.80^{mm} to 0.30^{mm} in diameter. It was evidently mainly derived from comminuted trachyte and scoriaceous lava, probably from the little extinct volcano of Monte Nuovo close by. A sample of the sand was taken February 1 from among the roots of the *Euphorbia Paralias* and *Matthiola sinuata* and analyzed gravimetrically for chlorin. It contained 7.3 per cent. of moisture, which contained a trifle more than 0.04^{mg} chlorin

per gram. In round numbers, 0.2 per cent. of the moisture was sea water. This extremely low per centage of chlorin accords with the fact that waves never in ordinary storms wash up as far as the level on which the plants were growing. They must, however, sometimes break into spray which reaches the station of the association studied. For the purpose of getting data for comparison of the salinity of the sand above described with other marine sands and soils and with ordinary garden soil, I made some further analyses, which are summarized in the table below.

	Per cent. Cl	Per cent. sea water	Per cent. water	Sea water per cent. of total water
1. Beach sand, Bay of Baiae (Association A)	0.0003	0.015	7.3	0.19
2. Beach sand, Mare Morto	0.0163	0.807	21.4	3.76
3. Beach mud, Lake Lucrinus	0.0125	0.619	52.5	2.23
4. Loam from vineyard near Pozzuoli	0.00025		25.0	

The second column of the table shows what proportion of sea water present in the sand or mud would account for the amount of chlorin actually found. The third column gives the total moisture present, and the fourth column shows what proportion of total water in the soil was sea water. The calculations are based on the assumption that the water of this portion of the Mediterranean contains in 1,000 parts about as follows:[2] NaCl, 28.76; KCl, 0.66; MgCl, 3.25.

In the beach sand from Mare Morto (no. 2) was found an association consisting of *Polygonum maritimum*, *Salsola Kali Tragus*, and a species of grass undeterminable at this season. In the immediate neighborhood occurred occasional specimens of *Aster Tripolium* and much *Plantago Coronopus*.

In the beach mud from Lake Lucrinus (no. 3) I found no member of Association A except *Inula viscosa*. This was extremely luxuriant, with branches attaining a diameter of 4^{cm} instead of the diameter of 0.8 to 1^{cm} usual in ordinary localities. The only associates identified in the very limited area examined were *Statice Limonium*, *Ficus Carica*, and *Inula crithmoides* (?).

It is evident from the analyses given that none of the soils examined were saline in any such degree as the familiar salt marshes of the

[2] ROTH, JUSTUS, Allgemeine und Chemische Geologie 1:524. 1879.

New England coast and the maritime provinces of Canada.[3] I have not indeed been able to find any typical salt marshes in the Naples region, since the beaches are often for long distances walled or protected by riprap against the encroachment of the sea, and nearly land-locked bodies of salt water such as Lake Lucrinus and the Mare Morto are surrounded by vertical stone walls, to admit of the utilization of the adjacent land to the water's edge.

It would *a priori* seem probable that the plants of Association A would belong to the category of littoral species rather than of genuine halophytes, and the results of my cultures confirm this supposition.

It seemed to the writer that the questions most worthy of investigation in connection with the association studied were: (1) the relative sensitiveness of the species to the effect of sea water or sodium chlorid solutions;[4] (2) the relative sensitiveness of strand-grown and inland-grown specimens of the same species to the effect of such solutions.

Thrifty self-sown seedlings of the species of Euphorbia, Matthiola, and Senecio in the list of members of Association A were found in great abundance, and therefore special attention was given to these species, though larger plants of all the others which could be obtained in good condition were also studied. Sea water and pure sodium chlorid, in solutions ranging from 1 to 6 per cent. of the salt were used for the cultures. The roots of the plants were partially freed from adhering sand or earth by careful immersion in a solution of the same strength as that employed in the culture, and then the plants were transferred to small tumblers containing the culture solution in which the roots were immersed. Each tumbler was covered by a disk of waterproofed pasteboard, fitted around the protruding stems of the seedlings, sufficiently close to prevent much evaporation, but not to hinder aeration of the solution. The room temperature during the two and a half months devoted to the investigation usually ranged between 12° or 15° C. by night and 20° or 22° by day, and the plants were about 1.5^m in front of a south window 2.5^m wide.

3 See GANONG, W. F., The vegetation of the Bay of Fundy salt and diked marshes. Bot. Gaz. **36**: 286, 292. 1903.

4 The writer took for granted the accuracy of H. COUPIN'S statement that the fatal effect of sea water upon vegetation is due to its sodium chlorid. See his article: Sur la toxicité de chlorure de sodium, etc. Rev. Gén. Botanique **10**: 177. 1898.

In order to avoid the possible presence of traces of salts of copper or other injurious metals sometimes found in distilled water the solutions were made up with very pure cistern water.

Much difficulty was experienced in getting perfectly comparable results from the fact that slight individual differences in the plants (such as relative development of the root system) made decided differences in their tolerance of the saline solutions employed. Many values were discarded, from the fact that they were evidently erroneous from variations of this kind. In general, as was to be expected, the duration of life in sea water was considerably greater than in a pure sodium chlorid solution containing the same per cent. of this salt (2.88) that is found in Mediterranean sea water. Some of the principal results obtained are summarized in the following table:

ORDER OF RESISTANCE TO SALINE SOLUTIONS.

	In 2.88 per cent. solution NaCl, lived days	In 100 per cent. sea water, lived days
Euphorbia Paralias	17	20
Matthiola sinuata	16	19
Euphorbia terracina	11–13	9
Echinophora spinosa	15	7
Polygonum maritimum	9–10	
Alyssum maritimum (littoral)	8	7
" " (inland)		7
Senecio vulgaris (littoral)	3	5
" " (inland)		5

It is noteworthy that the littoral and the inland specimens of Alyssum and of Senecio were equal in their resisting power, as might have been expected from the comparatively equal amounts of chlorid in the beach sand and the vineyard soil.

Some experiments were made to ascertain the maximum per cent. of seawater which could be tolerated by the species of Association A without speedy appearance of symptoms of injury, such as partial drying up or death of shoots. Difficulty was found in discriminating between retardation of growth and weakening caused by culture under artificial conditions, and that due solely to the excessive salinity of the culture solutions. It was considered that a plant was unharmed if it showed no decided ill effects from the solution (except retarded

growth) after the culture had continued for a month. The results appended are only approximate.

PER CENT. OF SEA WATER TOLERATED WITHOUT SPEEDY INJURY.	
Matthiola sinuata	75
Euphorbia Paralias	63
Echinophora spinosa	50 or more
Polygonum maritimum	50
Euphorbia terracina	50 or less

For the sake of comparison a few cultures were made of species growing in full sunlight in the vineyard the soil of which was analyzed for chlorin as above given. All soon succumbed to the effect of 50 per cent. sea water (and in general still more readily to 1.5 per cent. sodium chloride solution). Classed according to the readiness with which they wilted and then died, their sensitiveness to the salts in solution was about in the following order.:

1. Lamium amplexicaule.
2. Fumaria Gussonii.
3. Papaver Rhoeas.
4. Polygonum aviculare monspeliensis.
5. Veronica Tournefortii.
6. Geranium molle.
7. Rumex bucephalophorus.
8. Euphorbia Peplus.
9. Anthemis arvensis var.

Roughly speaking, the order above given is that in which these annuals wither and die at the onset of the summer drought, except as regards no. 3, which persists well into the dry season.

In order to compare the behavior of the plants of Association A with that of true halophytes, cultivated in saline solutions, some seedlings of *Salsola Kali Tragus* were procured from the sand adjacent to Mare Morto, above described. The plants were 2–2.5^{cm} high and cultures were made of these in clean sand, rinsed with the saline solution to be used, and then flooded once a day with another portion of the solution, which was afterwards poured off. The concentrations employed were respectively of 4, 5, 5.5, 6, and 7 per cent. of sodium chlorid, and other specimens were cultivated in solutions without sand.

In sand the plants appeared normal up to and including 6 per cent. sodium chlorid solution, though growth was slow for all concentrations above 4 per cent. Without sand prompt loss of turgor was noticed in 6 per cent. solution, corresponding pretty nearly to that observed in the solution of 7 per cent. with sand. This dimin-

ished effect of the salt in the presence of sand is in accordance with the conclusions of TRUE and OGLEVEE[5] in regard to the lessened effect of toxic substances in aqueous solution in presence of inert and insoluble solids.

None of the work done was shaped with special reference to determining whether the injurious action of saline solutions on the plants examined was due to dehydrating or other physical effects, or whether it was purely toxic. A notable desiccation and shrinkage was often observed throughout the stem while the upper leaves and especially the terminal bud remained vigorous. This fact would tend to confirm the hypothesis that the lethal action of dissolved salts is of a physical character. On the other hand, the fact that a pure sodium chlorid solution is usually more quickly fatal than sea water containing the same amount of sodium chlorid plus other salts tends to confirm the toxic hypothesis. Probably both factors may cooperate to produce death. Apparently the relative ease with which root hairs of the species studied can be plasmolyzed does not bear any definite relation to the susceptibility of the species to the action of sodium chlorid solutions.

The principal conclusions reached may be summarized as follows:

1. Association A consists of members very unequally resistant to the action of pure sodium chlorid solutions and of sea water.

2. The tolerance of sodium chlorid on the part of some members of this association is considerably greater than that of ordinary non-littoral plants; in other words, they are facultative halophytes.

3. Many of the species of this association are typical psammophytes, none are typical halophytes.

4. Growth of a non-halophytic species for many generations in an atmosphere at times highly charged with saline spray does not bring about greater tolerance of saline solutions when absorbed by the roots.

5. The Salsola seedlings studied showed a tolerance of sodium chlorid solutions up to almost 6 per cent. as good as that of any member of Association A for the 2.88 per cent. solution.

NAPLES, ITALY.

[5] TRUE R. H., and OGLEVEE, C. S., The effect of the presence of insoluble substances on the toxic action of poisons. Bot. GAZETTE **39**:1–21. 1905.

NEW AND NOTEWORTHY NORTH AMERICAN SPECIES OF TRIFOLIUM.

HOMER DOLIVER HOUSE.

(WITH TWELVE FIGURES)

I. NEW OR NOTEWORTHY SPECIES OF THE UNITED STATES.

THE following notes upon the genus Trifolium are based upon material in the National Herbarium. All figures × 1½.

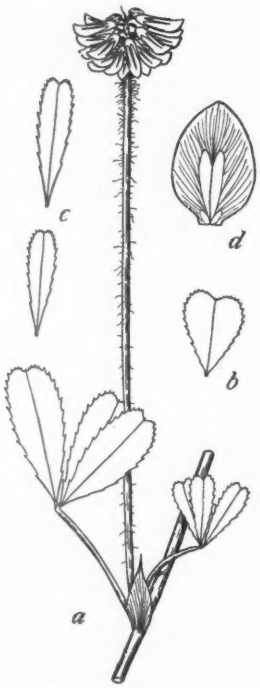

FIG. 1.—*Trifolium Greenei* House: *a*, portion of type specimen; *b*, leaflet from lower leaf; *c*, leaflets from upper leaves; *d*, banner.

Trifolium Greenei, nom. nov.—(*Fig. 1*). —*T. bifidum decipiens* Greene, Fl. Fran. 24. 1891; not *T. decipiens* Hornem., Hort. Hafn. 2:715. 1815.—Of much broader distribution and apparently not merging into *T. bifidum* Gray, though closely related to that species. It has more of the general appearance of *T. gracilentum* T. & G., but distinguished from it by its villous-pubescent peduncles and cuneate-oblong, subglaucous, and retuse leaflets.

Low moist places or natural grassy meadows, from San Diego to Mendocino and Butte Counties, California. The type, collected at Berkeley by *Greene*, is in the herbarium of Professor Greene.

TRIFOLIUN BIFIDUM Gray (*fig. 2*) seems to be a species peculiar to the bay region of California only; the type, collected by *Brewer* (no. 1184, 1862), "near Marsh's Ranch, between Monte Diablo and the San Joaquin (Contra Costa Co.), among grass in a ravine near the water, May 29," is in the National Herbarium.

TRIFOLIUM BREWERI S. Wats., Proc. Am. Acad. 11:131. 1876.—*T. amabile* Loja., Nuovo Giorn. Bot. 15:142. 1883, ex descr.

A careful reading of LOJACONO's paper on North American species of Trifolium makes very apparent the fact that he had a very scanty representation of the forms and distribution of our western species. While his descriptions are excellent, he has failed in many instances to determine properly the types of the species.

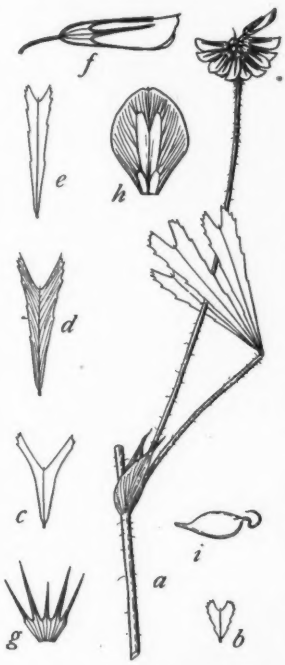

FIG. 2.—*Trifolium bifidum* A. Gray: *a*, portion of type specimen; *b* and *c*, leaflets from lower leaves; *d* and *e*, leaflets from upper leaves; *f*, flower; *g*, calyx expanded; *h*, banner; *i*, legume.

Trifolium Douglasii, nom. nov.—*T. altissimum* Dougl., Hook. Fl. Bor.-Am. 1:130. *pl. 48.*, 1830; not *T. altissimum* Lois. 1807.

An abundant clover in moist or natural wet meadows of eastern Washington, Oregon, and adjacent Idaho. Flowering in June and July, fruiting from July to the end of August.

TRIFOLIUM HARNEYENSE Howell, Fl. Northwest Am. 134. 1898.—*T. arcuatum Cusickii* Piper, Bull. Torr. Bot. Club 29:642. 1902.

An examination of the floral parts of the available herbarium material of *T. Harneyense* and *T. arcuatum Cusickii* shows them to be identical.

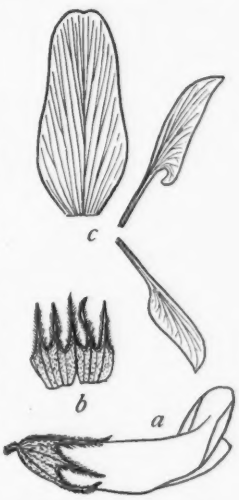

FIG. 3.—*Trifolium villiferum* House: *a*, flower; *b*, calyx expanded; *c*, banner, wing, and keel.

Trifolium villiferum, sp. nov.—*Fig. 3.*—Related to *T. eriocephalum* Nutt. Stems slender, erect, from perennial, ascending, and branching roots, 25 to 35^{cm} high, densely villous-pubescent with long hairs, stem nearly glabrous at base only: leaflets oblong-lanceolate, 2.5 to 4^{cm} long, 6 to 13^{mm} wide, obtuse at base, usually acute at apex, irregularly and inconspicuously repand-denticulate, pale green, appearing almost glaucous by the dense, whitish indument, scarcely less

pubescent above than below; petioles 3 to 7^{cm} long, uppermost shortest; stipules lanceolate or the upper ovate-lanceolate, subfoliaceous, 2 to 3.5^{cm} long, acuminate, entire or sparingly toothed: inflorescence pseudo-terminal; peduncles 6 to 13^{cm} long; heads densely many-flowered, ovoid when young, flowers all becoming strongly reflexed: calyx densely villous with shaggy hairs without especially toward the apex, tube about 2^{mm} long, the 5 subulate nearly equal teeth plumose, 3 to 4^{mm} long, somewhat bent in age: corolla pinkish-purple, 12 to 14^{mm} long; banner oblong, rounded or obscurely retuse at apex, broadest (about 6^{mm}) below the middle; wings shorter, tapering to a blunt apex, blade with a strong basal auricle; keel still shorter and more acute: legume ovoid, sessile, densely plumose-pubescent, pubescence extending nearly to tip of style, 2-seeded.

Flowering in June and July, fruiting in July and August. Southern Utah, *Palmer* (no. 91), 1877 (type in the U. S. National Herbarium); Burrville, Sevier Co., *Jones* (no. 5642a), July 17, 1894, 2100^{m} alt.; Deep Creek, *Jones*, June 6, 1891.

FIG. 4.—*Trifolium shastense* House.

Trifolium atrorubens (Greene), comb. nov. —*T. Rusbyi atrorubens* Greene, Erythea **4**:66. 1896.

Type, collected by *Parish* (no. 3745), Buff Lake, San Bernardino Co., California, June 21–27, 1895, in the herbarium of Professor Greene.

Examination of the type and several other sheets of *T. atrorubens* from southern California shows that it is not nearly so closely related to *T. Rusbyi* as to *T. pedunculatum* Rydb., and should properly be given specific rank.

Trifolium shastense, sp. nov.—*Fig. 4.*—Related to *T. longipes* and *T. oreganum*. Stems numerous from matted, branching, and slender rootstocks (forming a sod), 10 to 15^{cm} high; silky pubescent above and beneath on the leaves; stems purplish below: stipules lanceolate, green, aristate-acuminate, entire or few-toothed, 12 to 20^{mm} long; leaflets lanceolate, acute at base, often broadest above the middle, apex aristate-acuminate, margins prominently spinulose-

denticulate, glabrous above, silky-pubescent beneath, 15 to 25^{mm} long, 4 to 7^{mm} wide; leaflets of the lower leaves relatively broader and shorter, nearly obovate-cuneate, acute or rounded; petioles mostly shorter than leaflets, but lower ones longer: inflorescence usually solitary; peduncles 5 to 8^{cm} long, somewhat woolly-pubescent above with whitish hairs, densely many-flowered in a globose head; flowers sessile, the outermost spreading or becoming reflexed, 10 to 13^{mm} long: calyx silky-pubescent or becoming glabrate, tube 1.5 to 2.5^{mm} long, the five filiform-subulate teeth straight, 8 to 10^{mm} long, upper ones shortest and scarcely more than 8^{mm} long, sometimes shorter: banner sublanceolate, broadest (about 5^{mm}) below the middle, acuminate-pointed at the apex; wings and keel shorter, wings conspicuously attenuate-pointed, keel acute: legume stipitate, 2-seeded.

North side of Mt. Shasta, Siskiyou Co., California, 1500–2700^{m} alt. Collected by *H. E. Brown* (no. 362), type in the U. S. National Herbarium, June 11–16, 1897. No. 365 of the same collection is identical.

Remarkable for its sharply serrated and pointed leaflets, acuminate-pointed banner, and attenuate-pointed wings.

Trifolium Covillei, sp. nov.—*Fig. 5.*—Related to *T. latifolium*. Stems very short and leafy, several from a solitary, perpendicular thickened perennial root and appearing as a dense green mat at its apex, the root 10 to 20^{cm} deep; stems 1 to 3^{cm} long: stipules small, ovate, 5 to 7^{mm} long, blunt and often rounded at apex, entire, adnate to the petiole for two-thirds their length; leaflets obovate-subcuneate, rounded or retuse at apex, rarely the upper acute, margins finely but not sharply or conspicuouly toothed, 6 to 12 ^{mm} long, silky pubescent beneath, glabrous above; petioles mostly shorter or but little longer than the leaflets: peduncles 8 to 10^{cm} long, much exceeding the leafy part of the plant, silky-pubescent above; heads globose, 40 to 60-flowered, 2 to 2.5^{cm} in diameter, some of the flowers spreading or becoming reflexed,

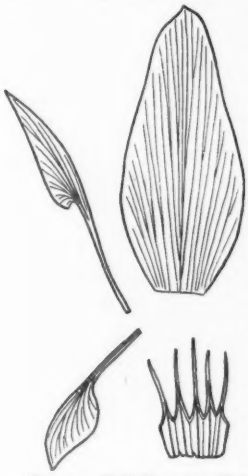

FIG. 5.—*Trifolium Covillei* House.

all sub-sessile: calyx membranaceous, the tube 1.5 to 2^{mm} long, sparingly hairy above, the 5 filiform-subulate teeth subequal, 2.5 to 3.5^{mm} long: banner yellowish, 12 to 14^{mm} long, inflated and including the wings and keel, broadest (6 to 7^{mm}) below the middle, acute, wings subacuminate, keel acute: legume short-stipitate, 2-seeded.

Bog-lands in the Wenatchee Mountains, Kittitas Co., Washington, *Coville* (no. 1180), Sept. 4, 1901 (type in the U. S. National Herbarium).

The group of small species related to *T. monanthum* Gray has been not a little confused by various authors, and the location of the type in the U. S. National Herbarium makes it possible to define definitely its critical parts. The accompanying description and drawing are from the type.

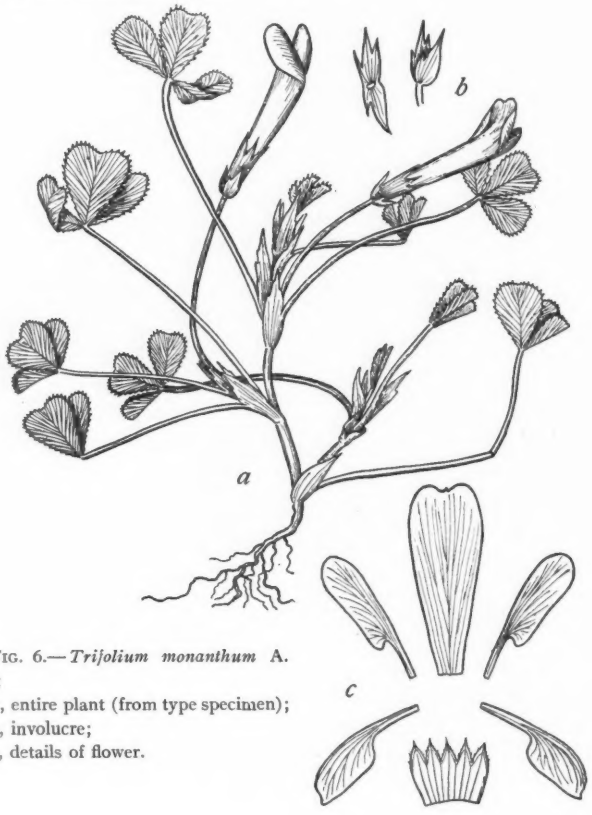

FIG. 6.—*Trifolium monanthum* A. Gray:
a, entire plant (from type specimen);
b, involucre;
c, details of flower.

TRIFOLIUM MONANTHUM A. Gray, Proc. Am. Acad. **6**:523. 1865.—*Fig. 6.*—Perennial from numerous, slender, branching roots; stems branching from near the base, ascending, 2 to 4^{cm} high, only sparingly villous: stipules ovate-lanceolate, green, 3 to 5-nerved, cuspidate-acuminate, 2 to 4^{mm} long, entire or rarely with a few minute rigid teeth near the apex; leaflets obovate-cuneate, retuse or truncate at apex, margins spinulose-denticulate, 4 to 6^{mm} long, sessile, pale green with a few villous hairs beneath, darker green above, the ascending, branching whitish veins ending in the subcallous mucronate teeth of the margin; petioles filiform, longer than the leaflets: peduncles filiform, mostly shorter than the leaves, one-flowered (rarely 2), involucre of two entire or sparingly toothed, ovate-lanceolate, cuspidate-acuminate bracts, 2 to 3^{mm} long: calyx cylindrical, twice as long as involucre, about 4^{mm} long, sparingly villous, 10-nerved, 5 of the nerves more prominent than the others, the triangular-lanceolate, spinulose-acuminate teeth about one-third the length of the tube: corolla 9 to 12^{mm} long, purplish-white, the slender tube elongated and somewhat glandular, not scarious or inflated after flowering; banner lanceolate-obovate, retuse; wings shorter and rounded; keel sub-acute: legume stipitate, 2-seeded.

Flowering from the middle of June to September; fruiting from July to October.

Mountain meadows, banks, and grassy places, Sierra Nevada in California from Alpine to Tulare County, and in Ormsby County, Nevada; 2100 to 3000^{m} alt.

CALIFORNIA: Sierra Nevada, *Lemmon* 1875; Manachi Meadows, 2500^{m} alt., *Rothrock* (no. 307), Sept. 1875; Tuolumne Co.: "Moist bank by Soda Springs, alt. 2650^{m}," *Brewer*, June 26, 1863 (no. 1704), type in U. S. National Herbarium; vicinity of Tuolumne Meadows, 2600–2900^{m} alt., *Hall* and *Babcock*, July 1902 (no. 3625); Alpine Co.: Caple's Lakes, 2600^{m} alt., *Hansen*, June 21, 1892 (no. 351); Fresno Co.: meadows near Block mountain, 3000^{m} alt., *Hall and Chandler*, July 1900 (no. 613); Tulare Co. near Mineral King, 2750^{m} alt., *Coville and Funston*, Aug. 4, 1891 (no. 1473).

NEVADA: Ormsby Co.: Snow Valley, 2460–2615^{m} alt., *C. F. Baker*, July 8, 1902 (no. 1282).

TRIFOLIUM TENERUM Eastw., Bull. Torr. Bot. Club **29**:81. 1902. "Higher meadows on the trail to the South Fork of King's River (Fresno Co.), California. It was collected by the writer at Summit and Bearskin Meadows, July 1–13, 1899. The first named speci-

mens are considered the type specimens. Type in the Herbarium of the California Academy of Sciences."

Characterized by the canescent and softly villous foliage, strongly nerved and setosely serrulate leaflets; heads 1 to 6-flowered; involucre glabrous, of 2-5 separate, laciniate-aristate bracts, 2 to 4 mm long; banner of the corolla with three rounded teeth at the truncate apex; wings slender, as long as the banner, auriculate at base of blade; keel two-thirds as long, tipped with an obtuse erect beak, the keel itself purple, auricled at base; ovary obovate, pilose at summit, one-ovuled.

TRIFOLIUM GRANTIANUM Heller, Muhlenbergia 1:136.

Undoubtedly distinct from *T. tenerum* Eastw., as HELLER indicates, but it is unfortunate that the floral characters were not better described ["Calyx cylindrical, or somewhat campanulate, 4 mm long, the tube 2 mm long, more or less membranous, veins prominent; the narrowly lanceolate teeth aristate, green: corollas 1 cm long, slender, 2 mm across, whitish, the hood of the keel purple"] when it is considered that in this group of small species the floral characters are of the utmost importance.

Based on *Grant's* Number 6343, July 23, 1904, from San Bernardino Co., Calif.

TRIFOLIUM PARVUM (Kellogg) Heller, Muhlenbergia 1:114. 1905.—*Fig. 7.—T. pauciflorum* (?) var. *parvum* Kellogg, Proc. Cal. Acad. 5:54. 1873; *T. multicaule* Jones, Bull. Torr. Bot. Club 9:31. 1882.—The prostrate or slightly ascending stems 10 to 20 cm long, often many from a thickened root; softly silky-pubescent, sometimes densely so: leaflets obovate, retuse or obtuse or sometimes those of upper leaves short acute at apex, subcuneate at base, minutely spinulose-serrulate; stipules broadly ovate, sharply toothed and acute; petioles filiform, the lower 1 to 3 times the length of the leaflets, the upper scarcely longer than the leaflets: peduncles exceeding the leaves, 1 to 3 cm long, 1 to 7 (usually 2 to 5)-flowered; involucre 5 to 7-divided into triangular-lanceolate acute and entire segments, 1 to 2 mm long, these spreading in age, rarely somewhat toothed: calyx 3 to 4 mm long, villous-pubescent, the 5 triangular lanceolate teeth about equaling the tube in length, the lower one

a little shorter and broader than the others, all spinulose-acuminate: corolla a little more than twice the length of the calyx, white with a purple-tipped keel; banner narrowly oblong, about 10^{mm} long and 3.5 to 4.5^{mm} wide, deeply retuse at apex; wings and keel much shorter, the keel acute: legume 2-seeded.

Around springs and in natural moist meadows of the Sierra Nevada, California, from Nevada Co. to Acador Co., Yosemite Park, and Fresno Co., at 1500 to 2100^{m} alt.

Nevada Co.: Soda Springs, *Jones* (no. 2592), July 30, 1881 (type of *T. multicaule*, in U. S. National Herbarium); low ground on south side of Donner Lake, *Heller* (no. 6942), July 16, 1903.

Amador Co.: Bear River, *Hansen* (no. 1968), Aug. 30, 1896.

Yosemite Park: Hetch-Hetchy Trail, *Hall* and *Babcock* (no. 3385), July 1902.

Fresno Co.: Pine Ridge. *Hall* and *Chandler* (no. 256), June 15–25, 1900.

Trifolium simulans, sp. nov.—*Fig. 8.*—Perennial from slender, branching roots; stems numerous, prostrate or ascending, slender, 5 to 20^{cm} long, glabrous: stipules ovate-lanceolate, 6 to 10^{mm} long, green or the lower ones subscarious, spinulose-acuminate, and with a few aristate teeth, 5 to 7-nerved; leaflets oblong-lanceolate, the middle one and often the others cuneate, irregularly spinulose-denticulate, mucronate-tipped at the acute apex, 9 to 14^{mm} long, 2.5 to 5^{mm} wide; petioles filiform, 2 to 4 times the length of the leaflets: peduncles as slender and shorter than the petioles; involucre divided into 2 or 3 parts, these cleft again to make 5 to 7 narrow, spinulose-acuminate, conspicuously nerved, simple or few-toothed segments to the entire involucre: calyx short-pedicelled, glabrous, about twice the length of the involucre, teeth subulate-acuminate, 3 to 4^{mm} long, the lower slightly shorter: corolla very large for the size of the plant, white with a purple-tipped keel; banner narrowly oblong, about 15^{mm} long, 5^{mm} wide, retuse and mucronate at apex; wings

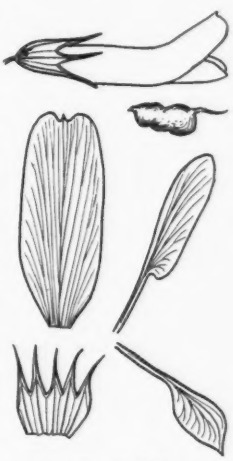

FIG. 8.—*Trifolium simulans* House.

and keel much shorter, blade of wings about 9^{mm} long, that of the acute keel only about 4^{mm} long: legume 2-seeded, sessile.

San Jacinto Mountains, California, 1800 to 2700^{m} alt., *H. M. Hall* (no. 710), July 22, 1897, type in the U. S. National Herbarium); Strawberry Creek (San Jacinto Mts.) 1600^{m} alt., *H. M. Hall* (no. 2200), June 20, 1901.

Resembling *T. parvum* in size, but very distinct from it in the remarkably large flowers for the size of the plant, the leaf, calyx, and corolla characters also showing well-marked differences. It appears to be as distinct from *T. parvum* as *T. tenerum* is from *T. monanthum*, and to show these differences descriptions of all three species are given.

II. MEXICAN SPECIES.

TRIFOLIUM AMABILE HBK., Nov. Sp. & Gen. **6**:503. *pl. 593.* 1823; *T. Humboldtii* Spreng., Syst. **3**:313. 1826 (*T. pauciflorum* Willd. herb.); *T. Hemsleyi* Loja., Nuovo Giorn. Bot. **15**:143. *pl. 4. fig. 1.* 1883.

One of the commonest species of Mexico and distributed from northern Mexico to Central America.

TRIFOLIUM GRACILENTUM T. & G., Fl. N. Am. **1**:316. 1838; *T. denudatum* Nutt., Proc. Acad. Phila. II. **1**:152. 1848.

Lower California, San Quentin Bay, *Palmer* (no. 613), Jan. 1889.

Trifolium longifolium (Hemsley), comb. nov.—*T. amabile* var. *longifolium* Hemsley, Biol. Cent. Am. Bot. **1**:232.1879; *T. goniocarpum* Loja., Nuovo Giorn. Bot. **15**:145. *pl. 4. fig. 2.* 1883.

HEMSLEY'S description is based upon *Parry* and *Palmer's* no. 134, although other specimens are mentioned. LOJACONO'S description is also based upon a plant collected by *Parry* and *Palmer*, but no collection number is given. His description, however, agrees well with a duplicate of HEMSLEY'S type in the National Herbarium, and the conclusion was forced upon me that they are identical.

San Luis Potosi, *Parry* and *Palmer* (no. 134), 1878: Chihuahua, *Pringle* (no. 1208), 1887; *Townsend* and *Barber* (no. 177), 1899; *Palmer* (no. 385), 1885: Durango, *Palmer* (no. 237), 1896: Tepic, *Rose*, Aug. 9, 1897: Jalisco, *Palmer* (no. 236), 1886: Aguascalientes, *Rose* and *Painter* (no. 7795), 1903: Federal Dist., *Pringle* (no. 7492), 1897: Vera Cruz, Orizaba, *Bourgeau*, 1865–66; *Seaton* (no. 93), 1891: Oaxaca, *Rose* and *Hough* (no. 4644), 1899.

Trifolium Lozani, sp. nov.—*Fig. 9.*—Related to *T. mexicanum*. Stems numerous, spreading and ascending from a perennial root densely silky-pubescent, 10 to 20^{cm} long; the internodes relatively

short: stipules ovate, lower scarious and entire, upper green and sparingly toothed, all acuminate, 6 to 10^{mm} long, 4 to 6^{mm} wide; leaflets cuneate-obovate or cuneate-oblong, sessile, 8 to 15^{mm} long, 5 to 10^{mm} wide, rounded at apex, glabrous above, sparingly pubescent beneath, subentire, the minute teeth very inconspicuous; petioles mostly shorter than the leaflets, or the lower slightly longer: peduncles scarcely exceeding the leaves, 1 to 3^{cm} long; heads globose, ebracteate, 25 to 50-flowered; flowers short-pedicelled, all becoming reflexed: calyx tube subcampanulate, pubescent, slightly more than 1^{mm} long; the subulate teeth twice as long, four of them ascending, lower one straight: corolla yellowish; banner broadly oblong, 5^{mm} long or less, retuse; wings and keel much shorter, subacute: legume oblong in outline, very blunt at apex, 3^{mm} long or less, 4-seeded: seeds nearly as thick and broad as long, smooth and brownish, less than 1^{mm} long.

FIG. 9.—*Trifolium Lozani* House.

Eslava, Federal District, 2300^{m} alt., *Pringle* (no. 9512), June 15, 1901 (type sheet no. 396298 in U. S. National Herbarium). Distributed as *T. amabile*, which it in no way resembles. It differs from *T. mexicanum* by its more densely pubescent stems and peduncles, smaller flowers, and relatively shorter calyx teeth. Named in honor of Señor Filemon LOZANO, assistant to Mr. PRINGLE.

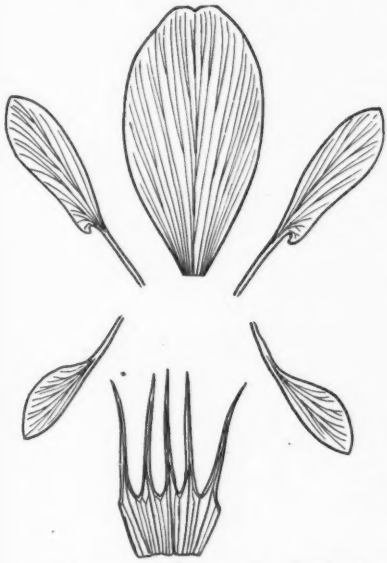

FIG. 10.—*Trifolium mexicanum* Hemsley.

TRIFOLIUM MEXICANUM Hemsley, Biol. Centr. Am. Bot. **1**:233. 1879.—*Fig. 10.*—*T. potosanum* Loja., Nuovo. Giorn. Bot. **15**: 144. *pl. 2.* 1883.

The type of *T. mexicanum* is from San Luis Potosi (*Parry* and *Palmer* no. 137, 1878), and upon the same number

is based *T. potosanum* Loja. A duplicate type is in the U. S. National Herbarium.

The following specimens from central Mexico differ from typical *T. mexicanum* in having larger flowers, more pubescent stems, and blunter leaflets, and are more spreading in habit. They may represent a variety, but scarcely more.

Mexico (state): hills near Ozumba, 2400^{m} alt., *Pringle* (no. 9775), Nov. 8, 1902; Flor de Maria, *Pringle* (no. 3238), Sept. 4, 1890; *Rose* and *Painter* (no. 7816), Oct. 13, 1903.

Trifolium Nelsoni, sp. nov.—*Fig.* 11.—Related somewhat to *T. mexicanum* but scarcely resembling it. Stems spreading and ascending from a perennial root, minutely pubescent, about 50^{cm} long or less: stipules ovate-lanceolate, green, rigid and the lower scarious, aristate-acuminate, entire, 15 to 20^{mm} long; leaflets ovate-lanceolate to elliptic-oblong, sparingly pubescent and pale beneath, green and glabrous above, usually with a whitish V-shaped blotch on the upper surface, apex acute or blunt, callous-tipped, margins inconspicuously repand-denticulate; petioles of the lower leaves 2 to 4 times the length of the leaflets: peduncles densely woolly-pubescent toward the summit, often 15 to 20^{cm} long; heads depressed-globose, 20 to 40-flowered, flowers subtended by subulate filiform bracts, 3 to 5^{mm} long; pedicels none or very short: calyx-tube 10-nerved, about 1.5^{mm} long, the subulate green teeth 4.5 to 5^{mm} long, subequal: corolla yellowish; banner 8 to 10^{mm} long, orbicular-obovate, slightly retuse at the apex or rounded; wings and keel shorter but relatively broad.

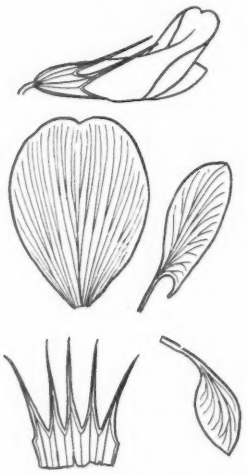

FIG. 11.—*Trifolium Nelsoni* House.

Vicinity of La Parada, Oaxaca, *E. W. Nelson* (no. 1016), Aug. 19, 1894 (type in the U. S. National Herbarium). Remarkable for the extremely broad petals.

TRIFOLIUM PALMERI S. Wats., Proc. Am. Acad. 11:132. 1876.

Guadalupe Island: *Palmer* (no. 26, 1875), type in Gray Herbarium; a duplicate type in herbaria of Professor Greene and Columbia University; *Greene* Apr. 21, 1885; *Palmer* (no. 859), 1889; Dr. *F. Franceschi*, 1893.

Trifolium cognatum, sp. nov.—*Fig. 12.*—Related to *T. longifolium.* Minutely pubescent or glabrate; stems spreading or ascending from a thickened perennial root, 10 to 30^{cm} high, often somewhat tinged with dull purple below, striate: stipules ovate or the lower ovate-lanceolate, green, acuminate, entire and scarious margined, 12 to 16^{mm} long; leaflets elliptical-oblong, subcuneate at base, glabrous, rounded and minutely mucronate at apex, 8 to 20^{mm} long, 4 to 10^{mm} wide, margins minutely and irregularly denticulate; petioles 2 to 4 times as long as the leaflets: peduncles exceeding the leaves; heads subglobose, 15 to 40-flowered; flowers erect when young, soon becoming entirely reflexed, their pedicels 2 to 4^{mm} long: calyx with a few scattered hairs, the tube 10-nerved, about 1^{mm} long, the subequal, subulate-acuminate teeth 3 to 3.5^{mm} long: corolla 7 to 9^{mm} long; banner violet-purple, ascending, retuse at apex, nearly 5^{mm} broad; wings and keel shorter and yellowish: legume 3 or 4-seeded.

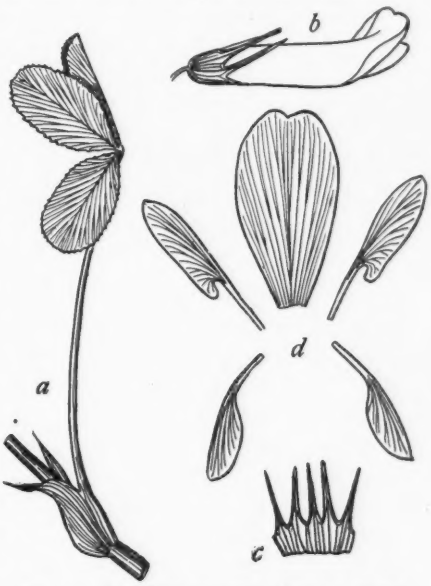

FIG. 12.—*Trifolium cognatum* House: *a*, stipule and leaflets; *b*, flower; *c*, calyx expanded; *d*, banner, wings, and keel.

Barren hills above Pachuca, Hidalgo, 2600–2900^{m} alt., *Pringle* (no. 6933), July 30, 1898. Type in U. S. National Herbarium.

Although fully matured legumes are not present on the type, the species is evidently related to *T. longifolium* (*T. goniocarpum* Loja.), from which it is distinguished by its larger flowers, slight pubescence, rounded or blunter leaflets, and more slender ovary. Peculiar in the purplish banner and yellowish wings and keel, the reverse of the condition of coloring usually seen in clovers with purple and yellow flowers.

TRIFOLIUM REPENS L., Sp. Pl. 767. 1753.

Reported by authors from the valley of Mexico and specimens from Central America have been examined. Probably introduced and escaped about many of the larger cities and seaports.

TRIFOLIUM MICROCEPHALUM Pursh, Fl. Am. Sept. **2**:478. 1814.

Guadalupe Island, *Palmer* (no. 831), Apr. 1, 1889. Probably also occurring in northern Lower California.

TRIFOLIUM RHOMBEUM S. Schauer, Linnaea **20**:740. 1847.

As I have not been able to establish fully the identity of this species, further than to advance the suggestion that it is perhaps the *T. mexicanum* of Hemsley, the original description is given here in full.

"*Trifolium* (*Trifoliastrum*) *rhombeum* S. Schauer: caulibus adscendentibus striatis cum petiolis pedunculis calycibusque villoso-lanuginosis, foliolis rhombeo-ellipticis obtusis mucronatis arguta denticulatis striato-venosis supra glabris subtus pilosiusculis glabrescentibus, stipulis membranaceis lato-ovatis mucronulatis pilosulis, capitulis axillaribus longe pedunculatis multifloris densis exinvolucratis, floribus pedicellatis demumque deflexis, calycis laciniis subaequalibus setaceis erectis tubo brevi longioribus corolla tertia brevioribus glabris.

"In montosis Mexici. Aschenb. n. 164. (perennial).

"Ex typo *Tr. hybridi* nostratis; inter mexicana forte affine *Tr. amabili* HBK., ceterum pubescentia, foliorum figura et serratura floribusque magnis insignis. Petioli 6–9 lin. longi, stipulis duplo longiores; foliola subpollicaria. Pedunculi folium longe excedentes. Flores magni, vexillo 4 lin. aequante Corolla alba vel pallide rosea ex sicco videtur, vexillum emarginatum."

TRIFOLIUM SCHIEDEANUM S. Wats., Proc. Am. Acad. **17**:338. 1883.—*T. reflexum* Schlecht., Linnaea **5**:576. 1830; not L.

"Jalapa (*Schiede*), and at Lerios, 45 miles east of Saltillo, [*E. Palmer*] (201)."

The locality for Schiede's plant as given by SCHLECHTENDAL is "Prope Jalapan ad latera montis Macultepec, San Andres inque graminosis."

A duplicate of Palmer's plant mentioned above is in U. S. Nat. Herbarium.

TRIFOLIUM TRIDENTATUM Lindl., Bot. Reg. sub *pl. 1070.* 1827.

Lower California, Todos Santos Island, *Anthony* (no. 194), 1897; San Quentin Bay, *Palmer* (no. 697), 1889.

TRIFOLIUM WILLDENOVII Spreng., Syst. **3**:208. 1826.—*T. involucratum* Orteg., Hort. Matr. Dec. 33. 1797; Willd., Sp. Pl. **3**:1372.

1801; not *T. involucratum* Lam. 1778; *T. Ortegae* Greene, Pittonia 3:186. 1897.

Both WILLDENOW and SPRENGEL seem uncertain regarding the native country of this species and the identification of Willdenow's name with an American species is perhaps first made by HBK. (Nov. Gen. & Sp. 6:502. 1823): "Crescit prope Valladolid Mexicanorum alt. 1000 hex."

This species, not rare throughout northern Mexico, is not at all closely related to the species of California which for so long has passed as *T. involucratum* and which Professor GREENE has shown to be *T. Wormskioldii* Lehm.

The important characters of *T. Willdenovii* are the linear-lanceolate stipules, subulate-acuminate and lacerate-toothed; the involucre divided nearly to the base into 6 to 8 nearly simple, subulate-aristate segments, resembling in this respect the *T. spinulosum* of northwestern United States, but not *T. Wormskioldii* of California. The leaflets are all linear and apiculate, except those of the lower leaves which are relatively broader; the purple flowers are from 16 to 18^{mm} long, in large erect heads; the banner very narrow and retuse at apex.

Chihuahua: *Nelson* (no. 6054), 1899; *Townsend* and *Barber* (no. 60), 1899, *Goldman* (no. 430), 1899; *Palmer* (no. 309), 1885; *Pringle* (no. 1209), 1887.

Durango: *Palmer* (no. 238), 1896; *Nelson* (no. 4768), 1898.

San Luis Potosi: *Parry* and *Palmer* (no. 135), 1878; *Schaffner* (no. 602), 1879.

Valley of Mexico: *Bourgeau* (no. 79), 1865–66; Pedregal, near Tlalpam, *Rose* and *Hough* (no. 4518), 1899.

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BRIEFER ARTICLES

THE BASIDIUM OF AMANITA BISPORIGERA.[1]

(WITH SEVENTEEN FIGURES)

THERE are among the Hymenomycetes certain species which have basidia bearing only two spores instead of the usual four. Such a form is sometimes found in a genus the other members of which have basidia with the usual number of spores. Some time ago while studying the structure of a white Amanita which resembles *A. verna*, Professor ATKINSON discovered that certain of the plants had basidia with only two spores. He also found that the two-spored plant could be distinguished from the four-spored *A. verna* by other characters, and he has described it as a new species, *A. bisporigera*.

AMANITA BISPORIGERA.

Amanita bisporigera Atkinson, n. sp.—Plants entirely white, usually occurring singly, about 9–13^{cm} high; pileus 4–6.5^{cm} broad; stem 5–8^{mm} thick; bulb 2–2.5^{cm} thick. Pileus convex to expanded, thin, often gibbous or somewhat broadly umbonate, smooth, viscid when moist, thin. Gills subelliptical, usually tapering more behind where they are rounded and free but close, rather crowded, edge of gills floccose. Basidia 2-spored. Spores globose to subglobose or oboval, smooth, with a minute pedicel where attached to the sterigmata as in many species, 8–10 μ. Stem nearly even, or slightly tapering upward, solid, when fresh finely floccose scaly both above and below the annulus, in age tending to become smooth especially below the annulus. Annulus thin, membranous, fragile, sometimes entire, sometimes torn, superior. Volva thick, with apical dehiscence and with the free limb splitting into two or three lobes which are usually closely appressed against the stem.

On the ground in woods. It has been found many times at Ithaca, N. Y. and vicinity, and specimens under twelve or more collections are in the Herbarium of the Department of Botany, Cornell University.

The plant bears a striking resemblance to *A. verna*, but is distinguished by its more slender habit and the two-spored basidia.

As this plant so closely resembles a four-spored species, it seemed desirable to study the nuclear phenomena in the basidium to determine how the behavior of the nuclei compares with what has been observed in the four-spored forms by WAGER (5, 6), JUEL (4), HARPER (2), and others. The results of a number of investigators make it seem very probable that in all Basidiomycetes the young basidium contains two small primary nuclei which fuse to form the secondary nucleus of the basidium.

[1] Contributions from the Department of Botany, Cornell University, No. 108.

WAGER, however, was of the opinion that in some cases more than two nuclei move into the young basidium from the multinucleate cells of the hyphae. After the fusion of the primary nuclei, the secondary nucleus increases greatly in size. By two successive divisions of this nucleus, four nuclei are produced for the spores. In basidia with more than four spores, as in some Gastromycetes, there are probably more than two divisions. In Dacryomyces, which has basidia with only two spores, there has been some difference of opinion, but it seems probable that the two nuclear divisions take place in the usual way. DANGEARD (1) observed only one division in *D. deliquescens* Bull. ISTVÁNFFI (3) found that in *D. chrysocomus* Bull. there are two successive divisions, and the four nuclei arrange themselves in a row and move in pairs into the branches of the basidium.

However, the young spore receives but one nucleus, as one remains behind in each branch of the basidium. JUEL (4) worked with *D. deliquescens* Bull. and found that there are two successive divisions of the nucleus, but each spore receives a single nucleus, the others remaining behind in the basidium.

The material for this study was secured during the summer of 1904 from plants collected in the vicinity of Ithaca, N. Y. Small pieces were cut from the pilei of young plants soon after their collection and were placed in 1 per cent. chromacetic acid where they remained 12–24 hours. The material was then washed 3–4 hours in running water, dehydrated in grades of alcohol, and passed gradually into paraffin. Sections were cut 3–5 μ in thickness. In sections showing some mature spores several stages in the development of the basidium are found. It is better, however, for the study of the young stages to take sections from younger plants. In fixing material from plants so young that none of the basidia bear sterigmata, there is a possibility of confusing these plants with *A. verna*. To avoid this, small pieces were cut from the pilei of the young plants and these plants were then placed in a moist chamber and allowed to continue their growth until the spores were produced. Then by freehand sections of the pileus the species could be exactly determined. *A. bisporigera* is so distinct in appearance, however, on account of its more slender form, that after one becomes familiar with it there is no difficulty in distinguishing it from *A. verna*, even before it is fully mature.

The sections were stained with safranin and gentian violet, which gives very good results. The preparations were studied with Zeiss 2^{mm} apochromatic, 1.40 aperture, and oculars 8, 12, and 18. Drawings were made with camera lucida and ocular 18.

Material of the two-spored *Agaricus campestris* was prepared for study in the same way, but on account of the smaller size of the nuclei and the dense contents of the basidium, this plant does not offer favorable material.

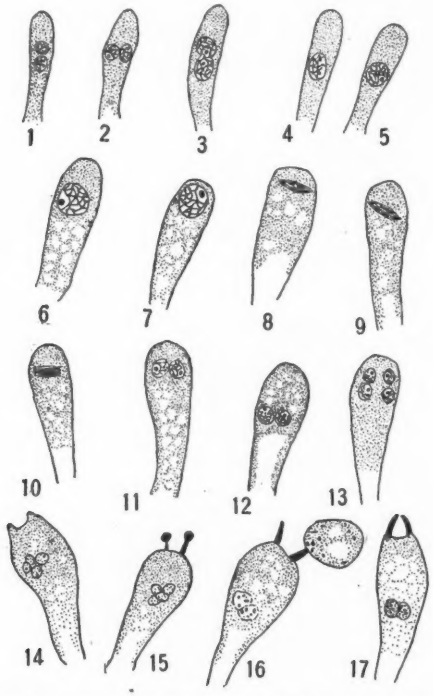

FIG. 1. Young basidium which is densely filled with cytoplasm and contains two primary nuclei.—FIG. 2. The membranes of the two nuclei are in contact.—FIG. 3. Two primary nuclei in the process of fusion, but the nucleoli indistinct.—FIG. 4. Fusion of the nuclei almost complete.—FIG. 5. Basidium somewhat increased in size after fusion of primary nuclei.—FIGS. 6 and 7. Older basidia in which the secondary nucleus occupies a position near the end of the basidium; structure of nucleus at this stage very distinct.—FIG. 8. Division of secondary nucleus.—FIG. 9. Chromosomes moving to the poles of the spindle.—FIG. 10. Chromosomes at poles of the spindle.—FIGS. 11 and 12. Daughter nuclei occupying different positions in basidium; usually near the end.—FIG. 13. Basidium showing four nuclei.—FIG. 14. The four nuclei crowded together at some distance from the end of the basidium and the sterigmata beginning to form.—FIG. 15. The cytoplasm beginning to pass through the sterigmata to form the spores.—FIG. 16. A basidium in which the spores are almost mature; two nuclei still seen near the center of the basidium.—FIG. 17. Old basidium from which spores have fallen; two nuclei near the center.

The young basidium first appears as a club-shaped branch from the sub-hymenial layer. It is more densely filled with protoplasm than in older stages and contains two nuclei. The structure of these nuclei can be made out very easily. Each nucleus has a rather large deeply staining nucleolus, a network in which the chromatin granules are imbedded, and a distinct nuclear membrane.

As the basidium increases in size the nuclei fuse together into one large nucleus. At first the two nuclei lie side by side with their membranes in contact and without apparent change. Then the membranes disappear at the point of contact. The nucleoli remain distinct for a short time, but finally fuse so that the large secondary nucleus produced by the fusion contains but a single nucleolus. The manner of the fusion of the threads bearing the chromatin could not be made out. After this fusion, the nucleus increases in size and comes to occupy a position near the upper expanded end of the basidium (*figs. 6* and *7*).

At this stage the structure of the nucleus can best be determined. It is so large that it fills more than two-thirds the diameter of the basidium. The nuclear membrane is very distinct, so that the nucleus stands out very clearly from the contents of the basidium, which at this stage have become vacuolate. The nucleolus is large and stains deeply, taking a reddish color with the triple stain. The nuclear network consists of one or more coiled threads in which are imbedded the chromatin granules, which stain blue or purple. Between the coils of the thread are the colorless spaces which are filled by the nuclear sap in the living cell.

The nuclear division takes place in the manner described by WAGER (5) for *A. muscaria*. The chromosomes are produced from the thread bearing the chromatin granules. The number of chromosomes is small, but I have been unable to determine the exact number. The chromosomes are small and stain deeply. The spindle consists of a small number of fibers, but they do not show the structures of fibers very clearly because they are crowded closely together. The spindle is arranged transversely near the apex of the basidium and is long and narrow with a small deeply staining body at each pole. Such spindles as the one shown in *fig. 8* are found frequently in the preparations. After the chromosomes move to the poles there are a few persisting spindle fibers which connect them. The daughter nuclei are now formed and usually occupy a position near the apex of the basidium (*fig. 11*). Each daughter nucleus has the same form and structure as the parent nucleus.

The most important question now is whether these two nuclei divide again to produce four nuclei, as is the case in plants with four spores on a

basidium. After careful search I have been unable to find the spindles of such a division, but numerous basidia which contained four nuclei have been observed. In some cases only three nuclei show in the section, but it seems probable that in all such cases the fourth nucleus is in another section. These nuclei are small and in most cases the structure is not so distinct as in the earlier nuclei of the basidium (*fig. 13*). The four nuclei move back from the apex of the basidium and become crowded together in an irregular mass in which it is difficult to distinguish the individual nuclei (*figs. 14* and *15*).

Soon after the four nuclei are formed, the two sterigmata grow out from the end of the basidium. The granular content of the basidium moves up and becomes more dense near the apex. Then the protoplasm begins to pass out through the sterigmata to form the spores. The question which now presents itself is as to the number of nuclei which pass into the spores. It is difficult to follow the details of the passage of the nucleus through the sterigma, and it seems to me that the best evidence as to the number of nuclei which enter the spores is found in the examination of old basidia in which the spores are fully mature or may have fallen off. Such basidia which contain only a small amount of cytoplasm show the presence of two nuclei (*fig. 17*). From the facts that the basidium when the sterigmata are formed contains four nuclei and that it contains only two when the spores are mature one may conclude that two nuclear divisions take place as in those forms with basidia which bear four spores, but that only two of the nuclei enter the spores.—CHARLES E. LEWIS, *Cornell University*.

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1. DANGEARD, Mémoire sur la réproduction sexuelle des Basidiomycétes. Le Botaniste IV. 1895.
2. HARPER, R. A., Binucleate cells in certain Hymenomycetes. BOT. GAZETTE 33:1–24. 1902.
3. ISTVÁNFFI, G., Ueber die Rolle der Zellkerne bei der Entwickelung der Pilze. Ber. Deutsch. Bot. Gesell. 13:—. 1895.
4. JUEL, H. O., Die Kerntheilungen in den Basidien und die Phylogenie der Basidiomyceten. Jahrb. Wiss. Bot. 32: 361. 1898.
5. WAGER, H., On nuclear division in the Hymenomycetes. Annals of Botany 7:489. 1893.
6. ———, On the presence of centrospheres in fungi. Ibid. 8:321. 1894.

CURRENT LITERATURE.

MINOR NOTICES.

The algae.—The second volume of OLTMANNS' large work on the algae has appeared.[1] This part treats of a variety of general topics, the first volume having been devoted especially to the different groups. Among the subjects are the algal cell, the development of reproductive organs, the nourishment of algae, life conditions, response to stimuli, polymorphism, life histories, adaptations, and a discussion of methods of collection, study, and culture. The two volumes give an excellent digest of the large literature in phycology and will prove very valuable as the starting point for many lines of further advance. Some of OLTMANNS' views, as for example that of the place of the tetraspore in the life history of red algae, are not likely to be sustained, but the work is a very scholarly contribution to botanical science and will be welcomed as the only publication of its class in the field of phycology.—B. M. DAVIS.

North American Flora.[2]—The general character and scope of this great work were stated in this journal in connection with the appearance of the first part.[3] Another part has now appeared, being a direct continuation of the former one, and both belong to volume 22 in the general scheme.

Saxifragaceae.—Conimitella, *Elmera*, and *Ocrearia* are established as new genera, and 30 other genera are recognized; new species are described under Lithophragma (8), Tellima, Mitella (2), Pectiantia, Ozomelis, Heuchera (25), Sullivantia, Therophon (3), Saxifraga, Muscaria (4), Micranthes (12), Spatularia, Leptasea (3), and Heterisia.

Hydrangeaceae.—Neodeutzia is established as a new genus, and 9 other genera are recognized; new species are described under Philadelphus (11) and Edwinia (2).—J. M. C.

Philippine plants.—Recent bulletins (nos. 29 and 35) from the Bureau of Government Laboratories show commendable activity in the study of Philippine plants. ELMER D. MERRILL, botanist of the laboratory, is publishing a series of papers on new or noteworthy plants, the third and fourth papers appearing

[1] OLTMANNS, F., Morphologie und Biologie der Algen. Zweiter Band. Allgemeiner Teil. 8vo. pp. vi+443. Jena: Gustav Fischer. 1905. *M* 12.

[2] North American Flora. Vol. 22. Part 2. Saxifragaceae, Hydrangeaceae, JOHN KUNKEL SMALL, PER AXEL RYDBERG. Cunoniaceae, Iteaceae, Hamamelidaceae, NATHANIEL LORD BRITTON. Petrostemonaceae, PERCY WILSON. Phyllonomaceae, HENRY HURD RUSBY. 8vo. pp. 81–191. New York: The New York Botanical Garden. December 18, 1905. Subscription price $1.50 for each part.

[3] BOT. GAZETTE **40**:74. 1905.

in the bulletins before us, and containing descriptions of nearly 150 new species. There are also notes on the Gramineae by E. HACKEL, including descriptions of 2 new species; an account of the Scitamineae by HENRY N. RIDLEY, 8 new species being characterized; and 10 new species of Acanthaceae by C. B. CLARKE.—J. M. C.

Aster.—In 1902[4] E. S. BURGESS published a "History of Pre-Clusian Botany in its relation to Aster;" and now a second paper on Aster has appeared,[5] which deals with the "Biotian Asters." Under the head of variation, specific limits in the genus are discussed; also normal characters and the comparative variability of organs. There is no group of flowering plants in which such a discussion would seem more difficult. A systematic treatment of the species is also begun, 84 species being presented with great fullness, 58 of which are published for the first time; also 10 subspecies and about 250 subordinate forms are characterized.—J. M. C.

Festuca.—C. V. PIPER[6] has published a monograph of the North American species of Festuca, recognizing 34 species, and characterizing 3 of them as new. A third subgenus is added to Vulpia and Eufestuca, to include *F. confinis* Vasey, and is called *Hesperochloa*. There are also notes on several Mexican species including descriptions of 2 new species. A new word is added to the terminology of grasses. The word "glume" is restricted to the "empty glumes;" while the "lower palet" or "outer palet" or "flowering glume" of authors is the *lemma*, a Greek word meaning husk or scale.—J. M. C.

Plants of the Bahamas.—Dr. C. F. MILLSPAUGH, Field Columbian Museum, has issued the first paper[7] of a series dealing with the flora of the Bahamas, Amaranthaceae, Euphorbiaceae, Rubiaceae, and Verbenaceae are presented, and a new species of Solanum is described. New species are also described under Iresine (2), Argythamnia (2), Euphorbia (3), Chiococca, Lantana, Valerianodes, and Callicarpa; and two new genera (*Nashia* and *Pseudocarpidium*) of Verbenaceae are established.—J. M. C.

Lichens of Santa Cruz.—A. W. C. R. HERRE[8] has published an account of the foliaceous and fruticose lichens of the Santa Cruz peninsula, which is a natural biological region lying west of San Francisco Bay and extending south-

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[4] Mem. Torr. Bot. Club, **10**.

[5] BURGESS, EDWARD SANFORD, Species and variations of Biotian Asters, with discussion of variability in Aster. Mem. Torr. Bot. Club **13**: 419. *figs. 108.* 1906.

[6] PIPER, CHARLES V., North American species of Festuca. Contrib. U. S. Nat. Herb. **10**: 1–48. *pls. 1–15.* 1906.

[7] MILLSPAUGH, C. F., Praenunciae Bahamenses. I. Field Columb. Mus. Bot. **2**: 137–184. 1906.

[8] HERRE, ALBERT W. C. T., The foliaceous and fruticose lichens of the Santa Cruz peninsula, California. Proc. Wash. Acad. Sci. **7**: 325–396. 1906.

ward to Monterey Bay. Species are described under 22 genera, Parmelia being the largest with 14 species; and new species are characterized under Cetraria, Usnea, Parmelia, and Gyrophra.—J. M. C.

Die natürlichen Pflanzenfamilien.—Part 223 continues the families of mosses by BROTHERUS, Hedwigiaceae being concluded; Fontinalaceae, Climaciaceae, Cryphaeaceae, Leucodontaceae, and Prionodontaceae being completed; and Spiridentaceae being begun.

The first part of the second supplement has also appeared, including the literature of 1899–1904 in reference to gymnosperms and monocotyledons, with a few pages beginning the dicotyledons.—J. M. C.

Index Filicum.—The sixth, seventh, and eighth fascicles of CHRISTENSEN'S work[9] have appeared with great promptness, carrying the references from *Gleichenia Cunninghamii* to *Polypodium basiattenuatum*. It should be urged upon colleges and libraries that so useful and thankless a task should be supported by adequate subscriptions.—J. M. C.

Text-book of pharmacognosy.—A new textbook of pharmacognosy by GILG[10] is worthy an English edition. It is the best illustrated text for ordinary student use that has appeared. The work would be still more valuable if a greater number of cuts showing the anatomical elements as they appear in powder had been included.—RAYMOND H. POND.

Plants of Bermuda.—A list of plants collected by the author in Bermuda in 1905 has been published privately by A. H. MOORE of Cambridge, Mass. The pamphlet contains 22 pages, 3 plate reproductions of photographs, and descriptions of new species of Rhynchospora and Elaeodendron.—J. M. C.

Das Pflanzenreich.[11]—Part 24, issued in January of this year, contains the Aponogetonaceae by KRAUSE and ENGLER, 22 species being recognized.—J. M. C.

NOTES FOR STUDENTS.

Items of taxonomic interest.—J. CARDOT continues (Bull. Herb. Boiss. II. **6**: 1–17. 1906) his account of the mosses collected by the Swedish Antarctic Expedition, describing nineteen new species from S. Georgia Island and 5 from the Antarctic lands.—PALIBRIN adds (*idem* 18–22) 5 new species to the Chinese flora.—H. CHRIST lists (*idem* 45–58) the ferns of Costa Rica, which is astonishingly rich, and describes 8 as new.—I. THÉRIOT (Bull. Acad. Int. Geog. Bot. **16**: 40. 1906) gives a 2-line diagnosis of two new Leptodontia from New Granada, with other

[9] CHRISTENSEN, C., Index Filicum, etc. Fasc. 6–8. Copenhagen: H. Hagerups Boghandel. 1905 and 1906. Each 3*s*. 6*d*.

[10] GILG, ERNEST, Lehrbuch der Pharmacognosie. 8vo, pp. vii + 368. Berlin: Julius Springer. 1905.

[11] ENGLER, A., Das Pflanzenreich. Heft. 24, Aponogetonaceae by K. KRAUSE assisted by A. ENGLER. pp. 22, *figs.* 9 (71). *M* 1.20. Leipzig: Wilhelm Engelmann. 1906.

new species from China.—E. L. GREENE characterizes (Ottawa Nat. **19**:197. 1906) a new Antennaria from Athabasca.—F. VON HÖHNEL describes (Ann. Mycologici **3**:404. 1905) a new genus, *Unguicularia*, near Pezizella, and 3 new species of fungi.—E. BRAINERD adds 2 new names to New England violets (Rhodora **7**:245–7. 1905).—M. L. FERNALD (*idem* 250) differentiates from *Cynoglossum virginicum* a new species, *C. boreale*.—J. A. CUSHMAN concludes (*idem* 251–266) his enumeration of the desmids of New Hampshire, listing 253 species and varieties against the 74 hitherto reported. He describes several new ones.—M. L. FERNALD (*idem* **8**:11 and 22. 1906) describes a new Geum from Vermont and a new Salix from Maine; attempts to clear up (*idem* 31) the American forms called *Arenaria verna*, including a new species; and characterizes (*idem* 69–71) 2 new species of Streptopus.—In a presentation of Astragalus and its segregates as represented in Colorado, P. A. RYDBERG (Bull. Torr. Bot. Club **32**:657–668. 1905) recognizes 17 genera, 7 of which (*Atelophragma*, *Jonesiella*, *Phacopsis*, *Ctenophyllum*, *Microphacos*, *Cnemidophacos*, and *Diholcos*) are characterized as new; and in his 16th paper on the Rocky Mt. flora (*idem* **33**:137–161. 1906) he describes new species under Rumex, Sphaeralcea, and Senecio (6); establishes as new genera *Crunocallis*, *Naiocrene*, *Erocallis* (all three near Claytonia), *Cornella* (Cornaceae), *Oreochrysum*, *Platyschkuhria*, *Chamaechaenactis*, and *Prenanthella* (all four Compositae).—In his 6th paper on the Hepaticae of Puerto Rico (*idem* 1–25), A. W. EVANS establishes *Rectolejeunea* and *Cystolejeunea* as new genera.—In a 5th paper describing new species of Uredineae (*idem* 27–34) J. C. ARTHUR establishes the new genus *Ceratelium*.—J. K. SMALL (*idem* 51–57), in a 2d paper on N. Am. Polygonaceae, describes new species under Eriogonum (8) and Polygonum.—L. M. UNDERWOOD and F. E. LLOYD (*idem* 101–124) describe 17 new species of Lycopodium from the American tropics.—L. M. UNDERWOOD (*idem* 189–205) characterizes new species of pteridophytes from the United States under Asplenium (2), Stenochlaena, Tectaria, and Selaginella.—R. SCHLECHTER (Engler's Bot. Jahrb. **39**:1–100. 1906) in a study of the flora of New Caledonia establishes 3 new genera (*Coilochilus*, *Pachyplectron*, *Gonatostylis*) of Orchidaceae and one (*Trilocularia*) of Balanopsidaceae.—U. DAMMER (*idem* 20–22) describes *Actinokentia* and *Nephrocarpus* as new genera of New Caledonian palms.—W. SUKSDORF (Oesterr. Bot. Zeits. **12**:5–7, 26, 27. 1906) has described new species of Washington plants under Sanicula, Lomatium, Antennaria, Lasthenia, Pyrola, Navaretia, Orthocarpus, and Aphyllon (2).—A. A. HELLER (Muhlenbergia **2**:1–164. 1905–6) has published an account of his Californian collections during 1905, including descriptions of new species under Eriogonum (3), Montia, Delphinium, Ranunculus, Thysanocarpus (2), Lithophragma, Ribes, Amelanchier, Lupinus (14), Vicia, Acrolasia, Boisduvalia, Glaux, Apocynum, Gilia (4), Solanum, Pentstemon, Castilleia, Orthocarpus, and Scorzonella; and of 2 new genera, *Hesperastragalus* (Leguminosae) and *Malacolepis* (Compositae).—MAX FLEISCHER (Hedwigia **45**:65–87. 1906), in concluding his paper on new families, genera, and species of mosses, describes *Baldwiniella*, *Homaliodendron*, *Pinnatella*, and *Penzigiella* as new genera of

Neckeraceae.—U. DAMMER (Notizblatt König. Bot. Gart. **4**:171–173. 1905) describes a new genus (*Kinetostigma*) of Guatemalan palms.—E. JANCZEWSKI (Bull. Acad. Sci. Cracovie, pp. 13. Jan. 1906), in his second paper on Ribes, presents the species of the subgenera Ribesia and Coreosma, including new Californian and Mexican species.—A. BORZI (Notarisia **21**:14–16. 1906) describes a new genus (*Zoddaea*) of Chlorophyceae (Chroolepidaceae) from a Mediterranean island.

Heredity.—A lecture on heredity and the origin of species by MACDOUGAL[12] not only presents the author's views regarding the several more prominent evolution hypotheses, but also makes the first public announcement of important results of his own researches on the causes of mutation.

While not denying the possibility of other means of production of species, he holds that hybridization and mutation are the only *demonstrated* methods by which new species have arisen. He attributes a popular belief in the Neo-Lamarckian hypothesis to the supposed effects of garden practice, and these supposed effects are supposed to be due to the prevalence of vicinism and the vegetative propagation of bud-sports. Several "unsurmountable objections" are opposed to the Neo-Darwinian hypothesis of natural selection of slight variations as a universal method. He would distinguish orthogenesis from determinate variations, limiting the former to an internal perfecting force which evolves rudimentary organs and develops them to functional structures without any reference to selection; while the latter he would allow as a part of every method of evolutionary procedure, in that no structure may vary to any other structure too much unlike itself. This is a very important discrimination theoretically, but it is clear that in most cases a practical distinction between orthogenesis and determinate variation as here defined would be an impossibility, since the "morphological possibilities" may be estimated only by what does appear.

The effects of isolation and of self- and cross-fertilization are held to be problematical.

The greater part of the lecture is naturally devoted to the mutation cultures of DE VRIES and himself. Besides *Oenothera Lamarckiana*, the following three species have been shown to be in a state of mutation: *O. grandiflora*, *O. biennis*, and *O. cruciata*. "Parallel mutations" are exemplified by two observed origins of *nanella*-forms, i. e., forms with linear petals. A consideration of the mutating and mutant species leads to the conclusion that plants are made up of complex groups of unit characters, that some of these characters may exist for an indefinite time in a latent state, that a new character that departs widely from the parental condition is more variable than the homologous character of the parent species, and that at the same time it is less closely correlated.

[12] MACDOUGAL, D. T., Heredity and the origin of species. Lecture given before the Barnard Botanical Club, Columbia University, December 18, 1905. The Monist, Jan. 1906. 32 pages. Printed and distributed in advance.

The author substitutes for a *period* of mutation the conception of a nearly constant *frequency* of mutation. Thus, one plant in twenty of *O. Lamarckiana* is a mutant, but only one in two hundred of *O. biennis*. In others there may be one in ten thousand or one in a million.

Doubtless the most important fact presented is the result of investigations to determine the cause or causes of mutation. The introduction of strong osmotic and weak chemical solutions into the ovaries of *Raimannia odorata* shortly before fertilization, appears to have produced a large number of individuals of a hitherto unknown type. These new plants have a shorter life-cycle than that of the parent and are profoundly different in many characters. They have already bloomed and fruited, and obviously constitute a potential species. If this new species holds its characters in succeeding generations, this discovery will be one of far-reaching importance, as the first real clue to the causes which may effect mutative changes in plants.—GEORGE H. SHULL.

Graft-hybrids.—NOLL has made a careful morphological, anatomical, and cytological examination of the supposed graft-hybrids between *Crataegus monogyna* (stock) and *Mespilus germanica* (scion) in the Dardar Garden at Bronvaux near Metz, Germany.[13] Three branches, starting from the callus where stock and scion meet, present unmistakable evidence of their hybrid origin, each branch showing a different combination of the parental characters.

A consideration as to the possibility of graft-hybrids, in the light of present knowledge of the behavior of the hereditary substance, leads to the conclusion that they must originate through nuclear fusions in the callus or not at all; and moreover, that the studies of NĚMEC upon asexual nuclear fusions gives a basis of observed fact which warrants the affirmation that graft-hybrids are possible.

The cytological examination of the several hybrid branches showed that their cells do not possess double the normal sporophyte number of chromosomes; therefore, if these hybrids originated from the fusion of two vegetative cells, this process must have been followed by some method of chromosome reduction. This presents no insurmountable difficulty, since NĚMEC found that after 78 hours no nuclei were found which had more than the normal number of chromosomes, though many such were observed soon after fusion.

The greater resemblance of one of the hybrids to Mespilus, and of the other two to Crataegus, and the change of one of the latter from nearly typical Crataegus to near one of the other hybrid forms, are explained by assuming that in each fusion one nucleus remained in its accustomed cytoplasmic surroundings, and that the other nucleus, moving into unaccustomed surroundings, was so weakened or injured that, when the degeneration took place which reduced the chromosomes to their normal number, the weakened or injured chromosomes contributed the fewest determinants to the hybrid nucleus, thus giving the hybrid

[13] NOLL, T., Die Pfropf-Bastarde von Bronvaux. Sitzungsber. Niederrhein. Ges. f. Natur-u. Heilkunde Bonn, 1905. Separate, 34 pp.

a greater resemblance to the species furnishing the stationary or "mother-" nucleus.

The investigation shows that neither stock nor scion is itself of hybrid origin and that there can be no reasonable doubt that these are true graft-hybrids.

The only other similar case that has attracted much attention is that of *Laburnum* (*Cytisus*) *Adami*, and about this plant there has been so much contention that, in the absence of other authentic graft-hybrids and with the disappearance of the original tree, it seemed best to many botanists to consider the original observation and record to be in error. NOLL prints the original account in full, and decides, after considering the possible sources of error and misinterpretation, that the internal evidence in favor of this statement compels belief in its truth.

The final demonstration must lie in a reconstruction of the same or a similar hybrid, experimentally, and on this work NOLL has been engaged for a number of years, as yet with wholly negative results; but the rarity of the phenomenon makes this quite to be expected, and the author still hopes by improving his technic to succeed in re-creating *Laburnum Adami*.—GEORGE H. SHULL.

Experimental variation.—KLEBS[14] presents a paper which deserves special attention because of the experimental data recorded, because of the author's effort to make a closer analysis of the problem of experimental variation, and because a substitute for DE VRIES's intracellular pangenesis is offered. Long experience with the behavior of algae and fungi under artificial conditions, probably as much as the results stated in this paper, has convinced the author that in the last analysis all variations must be referred to the influence which external factors exert upon the inherent potencies of the organism. From this point of view the fundamental problem of experimental variation at once appears to be to determine the potential amplitude of variation for species. This problem is to be solved by the application of as great a variety of conditions as possible. Some of those used by the author are temperature, darkness, wounding, and artificial food. The results obtained with *Campanula trachelium* and *Sempervivum Funkii* show that the accepted taxonomic limits of a given species are easily transgressed whenever external conditions favor the expression of potencies inherent in the organism. Trial clearly shows that the potency of external conditions is much greater before the inception of organs than after. If, for example, nutrition is the determining factor for a given variation, it makes little difference whether the necessary nutrition status is established by one external condition or another.

Over one hundred pages are used to expound the author's view of the correlation of variation and environment and to present a polemic criticism of intracellular pangenesis. The results with *Sempervivum Funkii* show that those characters which can appear as specific within the genus can by proper method be induced to appear upon a single species. A species therefore is to be

[14] KLEBS, GEORG, Ueber Variationen der Blüten. Jahrb. Wiss. Bot. **42**: 155–320. *pl. 1. figs. 27.* 1906.

characterized only by its constant relation to the outer world, and the author believes any other definition is artificial and arbitrary. More explicitly, a species is defined as comprising all those individuals which have arisen by vegetative reproduction or by self fertilization, and which for many generations under like conditions have shown identical characters. This definition is not arbitrary to the reviewer, provided the assumption of a specific structure upon which it rests is not arbitrary. If by definition potencies can never transgress the limit prescribed by the specific structure and variation is merely the expression of potencies, how have species arisen by variation? The potencies of the author are merely inherent capacities to respond to certain combinations of external conditions and are purely immaterial as compared with the pangens of DE VRIES, which are material and carry the unit characters. To some investigators this discrimination will probably appeal as being an interpretation closer to nature and more logical from the strictly physiological standpoint. To others it may seem as merely a restatement of the conception of DE VRIES. The latter might easily inquire what difference it makes whether a given variation has arisen by an inactive pangen becoming active or by a hitherto impotent potency becoming potent.—RAYMOND H. POND.

The lakes of Scotland and Denmark.—At the invitation of Sir JOHN MURRAY, DR. C. WESENBERG-LUND[15] spent three or four weeks on the Scottish lakes in order to make a comparison with the lakes of Denmark. While this was a short time in which to make examination of a new country nevertheless we should expect interesting results from one who has not only accomplished so much thoroughly good work in the study of lakes, but has shown unusual skill and originality in his interpretations.

The general differences which the author finds between the Danish and Scottish lakes are the differences which we should expect between shallow and deep lakes. The Danish lakes have more plankton, more floating and submerged vegetation, and more distinct littoral zones of vegetation. The greater seasonal variations in the Danish lakes is noted; this, of course, would be expected from the greater variations in temperature. There are more highly colored crustacea in the Scottish than in the Danish lakes. The reviewer thinks the author right in correlating this red color with low temperature, rather than with elevation as has been done by some other authors.

Among the diatoms the author notes the absence of Melosira and Stephanodiscus in the Scottish lakes, with an abundance of Asterionella and Tabellaria. These facts compare well with the differences in America between the deep and shallow lakes. The Scottish lakes are remarkable for the large number of desmids. These desmids are of forms that are common in the pools of the hillsides. The occurrence of these desmids in the plankton, together

[15] WESENBERG-LUND, C., A comparative study of the lakes of Scotland and Denmark. Proc. Roy. Soc. Edinburgh **22**:401–488. *pls. 2.* 1905.

with the occurrence of Entomostraca that are also common in pools, leads the author to the generalization that the limnetic plankton of the Scottish lakes is of littoral origin, and that the transportation of these forms to become a part of the limnetic fauna and flora is favored by the steep hillsides surrounding the lakes, and the extremely narrow littoral region.

The author enters upon a somewhat detailed discussion of the influence of the organic life upon the lakes themselves, showing how in the Danish lakes the algae and higher plants make deposits of lime which are partly thrown upon the beach, and partly fall to the bottom in the limnetic region. In these bottom deposits it is again worked over by worms and insect larvae, which devour the remaining organic matter and leave the bottom sometimes composed almost entirely of lime and clay. In the Scottish lakes the bottom in the deeper portions is composed of material largely derived from the littoral and shore regions, and there is an absence of lime.

The general conclusion is that while the Danish lakes are filling up, the Scottish lakes will remain with very slight alteration for ages.—C. DWIGHT MARSH.

Chlorosis.—One of the most notable papers recently published on the type of diseases which may be classed as chlorosis is that of BAUR on the infectious chlorosis of the Malvaceae. The variegated mallows in cultivation were derived from a form of *Abutilon striatum* known as *A. Thomsoni*, which appeared in a collection of A. *striatum* imported into England from the West Indies in 1868. This plant was found to be capable of transmitting its variegation by grafting. BAUR finds that if the leaves are removed from variegated plants, or if the shoots are cut back so that no leaves remain and the plants kept in the dark, new shoots form only two or three variegated leaves, and if those are removed the plants remain permanently green in the light unless they are again infected from scions of variegated plants. However, if latent axillary buds on the old parts are forced into growth, these produce shoots with variegated leaves which in turn infect all newly formed leaves on the plant. When all variegated leaves are removed from a plant exposed to light, the plant becomes permanently green. Similarly when scions of the green but susceptible *A. arboreum* are grafted on defoliated variegated plants, the scions remain green, but here also if a variegated shoot is allowed to develop from the stock it rapidly infects the whole plant. The author concludes that the variegation in these plants is caused by a substance or virus which is formed only in the light in the chlorotic parts of the plants; that this virus is produced only in small excess so that it is rapidly used up if the variegated leaves are continually removed. The substance is capable of infecting only the embryonic leaves and in those it is stored for months in an inactive form. By appropriate girdling and grafting experiments the approximate rate of movement and the path followed was determined. Movement takes place in the cortex and not with the transpiration stream. When scions of immune *A. arboreum* are grafted on a variegated *A. Thomsoni*, they grow vigorously but are not infected;

but if scions of some susceptible species are grafted on the former these become infected, showing that the virus can pass unchanged through the intermediate piece of *A. arboreum*. These experiments seem to prove the existence in the plant of a substance which in its behavior is analogous to the supposed shoot-forming substance of SACHS, or the growth enzymes of BEYERINCK.—H. HASSELBRING.

Anatomy as a test of species.—ALFRED SARTON[16] has made an elaborate experimental study of the anatomy of related plants, to test the constancy of anatomical characters under varying conditions of climate and of soil. The work was done at the Botanical Laboratory of the Sorbonne and at the Laboratory of Plant Biology at Fontainebleau. He calls attention to the fact that there are two kinds of species recognized in taxonomic writings: one he calls the "Linnaean species," which often bring together under a single name a large number of different forms; the other he calls the "Jordanian species," which often consist of dismembered Linnaean species. These two kinds stand side by side as of equal rank, all of them based upon varying judgments as to the value of external morphological characters.

SARTON set out to discover whether real species could be detected by their anatomical characters. He reasons that nearly allied species whose anatomical differences may be exchanged under experiment are not separate species, however unlike they may appear externally; and that those whose anatomical differences are constant under experiment are true species, however similar they may appear externally. To test this dictum involved a large amount of laborious experimentation and anatomical investigation. The result was to pronounce some Jordanian species good and others not; and the Linnaean species shared the same fate. This anatomical method, therefore, furnishes no basis for judgment between the two types of species; and if it is used, it seems to the reviewer that it will result in readjusting specific lines without settling anything.

The fundamental weakness in this whole point of view is the idea that there can be any rigid test for that elusive conception known as a "species" which will carry it beyond the reach of fallible and hence diverse human judgment. It is of great interest to know what anatomical characters will vary under given conditions, and herein lies the chief value of this investigation; but even here the conditions are not analyzed so as to be convincing. To regard these characters as outweighing all others is to stir afresh the seething mess of taxonomy. What we need is not more "specifics" but more hygiene.—J. M. C.

Transpiration of evergreens.—PUGLISI[17] has published a paper on the transpiration of seven species of Chinese and Japanese evergreen trees and shrubs.

[16] SARTON, ALFRED, Recherches expérimentales sur l'anatomie des plantes affines. Ann. Sci. Nat. Bot. IX. **2**:1–115. *pls. 1–4.* 1905.

[17] PUGLISI, M., Sulla transpirazione di alcune piante a foglie sempreverdi. Annali di Botanica **2**:435–468. *pl. 2.* 1905.

His objects were (1) to compare the winter transpiration of these species in Rome with that already observed by KUSANO in Tokio during the winter; and (2) to compare the winter and summer transpiration in Rome. One set of experiments was made with single leaves exposed 24 hours in GARREAU'S apparatus, and another series with small twigs (in one case a leaf only) attached to MOLL potometers. The potometer measurements were usually continued for about 8 days and readings made at 9 A. M. and 5 P. M.

The author found the winter rate of transpiration at Rome decidedly greater than that at Tokio. He obtained for an average value of the ratio of winter to summer transpiration at Rome, for all the species examined, 1:3.10. The average ratio at Tokio of KUSANO'S "typical plants" (species not given) was 1:20.

PUGLISI reports that transpiration continued at night during the minimum temperature of his experiments, 2.6°. The rate of transpiration continued to increase with the rise of temperature up to and including the hottest days of July in which experiments were made.

There is a notable difference among the plants experimented upon in the sensitiveness to change of temperature. Measured by GARREAU'S method, *Ficus erecta* showed an increase of 1.5 times in the amount of transpiration when the temperature rose from 6.4° to 21.6°, and *Raphiolepis japonica* showed an increase of 7 times for about a degree more of rise than that of the Ficus.

The paper contains many interesting data, but the author has not sufficiently summarized his results. It seems unfortunate that so much stress is laid on observations made under the highly unnatural conditions imposed by the GARREAU method. All of the winter measurements were made by this method, which eliminates the effect of changes in relative humidity at a season when the actual range of this factor was from 58 to 95 per cent.—J. Y. BERGEN.

Plant breeding in the tropics.—LOCK[18] gives a further account of his studies in plant breeding at Peradeniya, Ceylon. His general conclusions were given in an earlier paper, and the present contribution describes in detail the experiments with the genus Pisum. Records of climatic conditions are given, and the changes which were induced in various European varieties on introduction into Ceylon. There was no gradual adjustment or acclimatization, the change of stature, habit, etc., being immediate and permanent during the several years of the investigations.

In all of the experiments wherein the characters are clearly alternate, the agreement with theoretical ratios is as close as the numbers used would warrant one to expect, on the hypothesis that the union of gametes bearing the several characters is purely a matter of chance. The author greatly weakens his paper, however, by pointing out Mendelian ratios where they are wholly unwarranted by his data, as for instance in width of pod (p. 371), where a variation curve with

[18] LOCK, R. H., Studies in plant breeding in the tropics. Ann. Roy. Bot. Gardens Peradeniya **2**:357–414. 1905.

millimeter classes showing the frequencies 1, 6, 5, 8, 4, 5, 2, 1, is grouped in a ratio of 7 wide : 17 medium : 8 narrow or nearly the expected 1:2:1. Every variation curve of purely chance variates can be arranged in this way by counting one-fourth of all the variates from each extreme, leaving the group between the quartiles as the 50 per cent. intermediates expected.

The author reaffirms in a general statement the explanation offered in his first paper,[19] to account for the appearance of certain *nova;* but makes an interesting observation in disagreement with that explanation, apparently without noting the discrepancy—the new character of the pigmented parent which was changed to the active state by crossing. He now states that he could occasionally observe the mottled pattern like a faint water mark in the *white* parent, and its occurrence there makes this an excellent new evidence that the mottled character is not latent in the usual sense of being *inactive*, and that it is *not* present in the pigmented parent, but being possessed by the *white* parent is simply *invisible* owing to the lack of pigment.—GEORGE H. SHULL.

Spraying potatoes.—STEWART, EUSTACE, and SIRRINE[20] have published the extensive results secured by them during 1904 in their series of experiments in the prevention of potato diseases by spraying. The results secured during previous years should be read in this connection.[21] During 1904 a total of fifty-eight experiments were conducted; a few of these were upon the grounds of the Experiment Station at Geneva, while the remainder were conducted as "farmers' business experiments" in various parts of the state. The experiments at Geneva form a part of a ten-year series of experiments designed to give average results for various seasons. The other experiments should yield valuable data year after year as to the actual net gains to be expected from the spraying against potato diseases under actual farm conditions. At Geneva five sprayings increased the yield 233 bushels per acre, while a gain of 191 bushels was secured from three sprayings. This gain was mostly due to the longer growth of the plants made possible by the prevention of the late blight and the rot which follows it. In the business experiments, covering a total of 180 acres, the net gain per acre due to spraying was $24.86. The average loss from blight in New York State during 1904 was not less than 60 bushels per acre. The suggestion is made that the community hire some person to do all their spraying, thus effecting a saving of time and labor.—E. MEAD WILCOX.

Alternation of generations in Phaeophyceae.—Strasburger[22] agrees with OLTMANNS that there is no alternation of generations in the Phaeosporeae. He

[19] See BOT. GAZETTE **39**:303–304. 1905.

[20] STEWART, F. C., EUSTACE, H. J., and SIRRINE, F. A., Potato spraying experiments in 1904. Bull. N. Y. Geneva Exp. Stat. 264:93–204. *pls. 1–16. 1 map.* 1905.

[21] Potato spraying experiments in 1902. Bull. N. Y. Geneva Exp. Stat. 221: 235–263. 1902.

Potato spraying experiments in 1903. Bull. N. Y. Geneva Exp. Stat. 241. 1903.

[22] STRASBURGER, EDWARD, Zur Frage eines Generationswechsels bei Phaeophyceen. Bot. Zeit. **64**:1–7. 1906.

believes that here, and also in the Chlorophyceae, the germination of the zygote will be found to be accompanied by a reduction of chromosomes, and that consequently a diploid, or $2x$ generation cannot be present. The absence of a diploid generation explains why parthenogenesis occurs so readily. Forms like the Dictyotaceae, which have a diploid generation, must be widely separated phylogenetically from the Phaeosporeae. The thallus of the Fucaceae is diploid, while from the initials of oogonia and antheridia to the mature eggs and sperms the condition is haploid, or gametophytic. The rather surprising view is expressed that the antheridia and oogonia of the Fucaceae are not homologous with those of the Dictyotaceae, but that they correspond rather to the tetraspore condition of the latter group. STRASBURGER makes the statement that the gametophytic generation begins with the complete separation of the $2x$ (*doppelzahligen*) chromosomes, because this separation furnishes the condition for the formation of sexual products. He does not indicate any more definitely that he would regard the spore rather than the spore mother-cell as the first term of the gametophyte.—CHARLES J. CHAMBERLAIN.

Diseases of sugar cane.—LEWTON-BRAIN finds that the root-disease of the sugar cane in Hawaii[23] is probably due to the fungus *Marasmius sacchari*, known to cause a similar disease in other countries. In Hawaii the fruiting body of the fungus has not yet been found. The Yellow Caledonia variety seems to be resistant to the disease while the Lahaina and Rose Bamboo are most severely injured. Ratoons are more injured than plant canes. Since this fungus is a soil-infesting fungus it may be controlled by liming the soil and through cultivation.

COBB[11] has recently published suggestions as to the inspection and disinfection of sugar cane cuttings to prevent the spread of sugar cane diseases.[24] The cuttings should be made with care to prevent the shattering of the ends, which permits the entrance of fungus parasites, and they should then be carefully inspected to get rid of any diseased ones that may be present. "Pickling" the cuttings in Bordeaux mixture is recommended, and a large part of the paper is devoted to methods of doing this work on the large scale required on a sugar plantation. The cuttings may also be sprayed with Bordeaux mixture in the ditch just before being covered.—E. MEAD WILCOX.

Asparagus rust.—SMITH, as a result of his further studies of the asparagus rust problem on the Pacific coast, finds that the rust may be effectively controlled or entirely prevented by the proper application of a dust spray of flowers of sulfur.[25]

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[23] LEWTON-BRAIN, L., Preliminary notes on root disease of sugar cane in Hawaii. Div. Path. and Phys. Exp. Stat. Hawaiian Sugar Planters' Association Bull. 2:1–39. *figs. 12.* 1905.

[24] COBB, N. A., The inspection and disinfection of cane cuttings. Div. Path. and Phys. Exp. Stat. of the Hawaiian Sugar Planters' Association Bull. 1:1–35, *pls. 8.* 1905.

[25] SMITH, R. E., Further experience in asparagus rust control. Calif. Exp. Stat. Bull. 172:1–21. *figs. 7.* 1906.

The important thing is to get the tops of the plants covered with a perfect coating of the sulfur dust before the rust appears; the first application should be made as soon as the tops have made some little growth, say about three weeks after cutting stops, and a second and perhaps a third application should follow at intervals of about one month each. In some cases it may prove advisable to spray the plants first with some soap spray, to be followed by the sulfur dust to insure the sulfur adhering to the plants. If the best grade of flowers of sulfur be employed, it may be possible to cover an acre with about fifty cents worth. SMITH insists also upon the supreme importance of destroying all wild asparagus plants near the regular fields, since on these the rust first appears, and from them the field soon becomes infested.—E. MEAD WILCOX.

Germination in myxomycetes.—In a preliminary paper on the germination of the spores of myxomycetes, JAHN recognizes two distinct types of germination.[26] The first type is represented by a single species of Ceratiomyxa, whose spore contains four nuclei, the spore content escaping as an amoeba which immediately divides into eight swarmspores. In the second type, embracing all other myxomycetes, the spores are uninucleate and produce a single swarmspore. Regarding the conditions of germination, the following observations are made. The amoeba escapes by rupturing the spore-membrane by osmotic pressure, and if this is increased germination is prevented. The spores of Stemonitis do not germinate when placed in water, but if after being soaked they are allowed to dry they will germinate readily in water, an observation formerly made by LISTER. JAHN concludes that such spores contain a latent enzyme which is made active by the process of moistening and drying. Since maltose but not other sugars causes germination, this assumption is strengthened, as maltose is the decomposition product produced from glycogen stored in the spores.—H. HASSELBRING.

Blight canker.—WHETZEL has published the results of his study of a canker of apple trees in New York state[28] due to the same organism, *Bacillus amylovorus*, that is responsible for the well-known fire blight of apples and pears. This canker has been known in a general way for some years, but this seems to be the first demonstration, by the usual inoculation experiments, of the bacterial nature of the disease. Infection seems to take place only through wounds, and these may be due to pruning, to accidental wounding or "barking" of the tree, or to the work of insects. The germ also enters at times through "water sprouts," since cankers are often seen to appear about the base of such blighted shoots. Pear trees known to be affected with the blight should not be allowed to remain in the neighborhood of an apple orchard, and great care chould be taken to prevent the dissemination of the germs on the pruning instruments. Some variation in resistance to the canker was noted.—E. MEAD WILCOX.

[27] JAHN, E., Myxomycetenstudien. Ber. Deutsch. Bot. Gesells. **23**:489–497. 1906.

[28] WHETZEL, H. H., The blight canker of apple trees. Bull. Cornell Exp. Sta. 236:99–138. *figs. 51–84.* 1906.

Excretion of acids by roots.—KUNZE[29] has extended the work of MOLISCH, PRIANISCHNIKOW, and CZAPEK on the general chemistry of the excretion of acids by roots, including a study of similar activity as exhibited by mycorhizal fungi. CZAPEK'S conclusion that the excretions do not contain free mineral acids is confirmed, but the presence of acid salts of the mineral acids is denied and the corrosive effect is attributed exclusively to the organic acids. Tests with about two hundred different species widely separated in systematic standing shows that many plants do not excrete enough acid from the roots to be detected by litmus. Fungi excrete much more actively and it seems probable that they are more potent as soil disintegrators than the roots of higher plants. The author's work tends to increase his belief in mycorhizal symbiosis. Whether intentional or not it seems a serious deficiency to omit the date from 23 of the total number of 35 citations.—RAYMOND H. POND.

Algae of northern seas.—An interesting paper by SIMMONS[30] discusses the history and relation of the algal floras of the North Atlantic and North Pacific to one another and to that of the Polar Sea. The Atlantic and Pacific Oceans are believed to have received a large number of species from the Polar Sea of Tertiary times, especially just before the ice age, when the algae were driven southward. Some of these became established and never returned to their old situations, but settled and became variously modified in their new life conditions. Others re-entered the Polar Sea with the retreat of the ice. This is a paper which will bear careful study by those familiar with the algal floras of the North Atlantic and Pacific, especially in comparison with BÖRGESEN'S *Algal vegetation of the Faeröese coasts* noticed in this journal **41**:71. 1906.—B. M. DAVIS.

Grape diseases.—BUTLER[31] has published some observations on three grape diseases: red-leaf, shrivel, and root-rot. The red-leaf seems to be a disease closely related to diseases known as *folletage*, *rougeot*, and California disease. Like the other diseases named, the red-leaf is probably due to disturbances in the balance between absorption of water by the roots and transpiration. It is possible that the disease may be checked to a considerable extent by increasing the fertility of the soil so as to render the plants more resistant. The shrivel is found mostly among the white grapes and is also due to disturbed nutrition or deficiency of water supply. The root-rot is similar to if not identical with the disease described in French literature as *pourridie*. It is caused by one or perhaps several fungi not yet fully determined. It often kills the vines in a single season but it may only kill the vines after three or more years.—E. MEAD WILCOX.

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[29] KUNZE, GUSTAV., Ueber Säureausscheidung bei Wurzeln und Pilzhyphen und ihre Bedeutung. Jahrb. Wiss. Bot. **42**:357–393. 1906.

[30] SIMMONS, H. G., Remarks about the relations of the floras of the Northern Atlantic, the Polar Sea, and the Northern Pacific. Beih. Bot. Centralbl. **19**:149–194. 1905.

[31] BUTLER, O., Observations on some vine diseases in Sonoma county, California. Bull. Calif. Exp. Stat. 168:1–29. *1 pl. figs. 1–5.* 1905.

Preserving plants.—POLLACCI, speaking before the Italian Botanical Society,[32] commends his method, proposed in 1900, for preserving plants in a watery solution of sulfur dioxid. Specimens so preserved in 1900 have retained perfectly their form and are in as good condition for sectioning as when fresh. He has improved the method of making the solution and has devised a means of retaining perfectly the green color. To make the solution, place sodium bisulfid in a large flask, add sulfuric acid drop by drop, and conduct the gaseous SO_2 through water, which quickly becomes saturated and may be preserved for use as needed. To retain green color immerse the material in a 1 per cent. watery solution of copper sulfate, leaving it 24 to 48 hours according to the consistence of the tissues; then transfer to the preservative solution.—C. R. B.

Teratology in Salix.[33]—MOTT records various cases of teratology in the flowers of two Californian willows, *S. lasiandra* Benth. and a hybrid of *S. lasiandra* Benth. and *S. babylonica* L. In making the statement that no mention has been made for Salix of an intimate association of microsporangial and megasporangial tissue he overlooks an earlier account by the reviewer,[34] who described and figured equally intimate associations. According to MOTT, the abnormalities indicate that the ancestral Salix flower consisted of a pistil and two stamens with a four-parted perianth, the present unisexual condition having been reached by the suppression of the organs of one sex. Hybridization seems to offer the most likely explanation of the abnormalities.—CHARLES J. CHAMBERLAIN.

Nectaries of Cruciferae.—VILLANI has made an exhaustive comparative study of the nectaries of Cruciferae[35] and concludes that on the basis of their number the Cruciferae can be divided into four types, and on the basis of their position into generic groups. The diverse forms as to nectaries are referable to one primitive type, having four nectaries, two of which are at the base and external to each stamen, constituting an external dimerous cycle, and two at the base and between each member of each pair of long stamens, constituting an internal dimerous cycle. The tetramery of the corolla is only apparent, the whole flower being purely dimerous. The nectaries function both for securing cross pollination and protection.—C. R. B.

Morphology of Chloranthus.—Miss HELEN M. ARMOUR[36] has published the results of her study of Chloranthus, especially interesting as extending our

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[32] POLLACCI, G., Nuovo metodo per la conservazione di organi vegetali. Bull. Soc. Bot. Ital. **1905**: 242.

[33] MOTT, WILLIAM WARNER, Teratology in the flowers of two Californian willows. Univ. Cal. Publ. Bot. **2**: 181–226. *pls. 19–20.* 1905.

[34] BOT. GAZ. **23**: 147–179. *pls. 12–17.* 1897.

[35] VILLANI, A., Dei nettarii delle Crocifere e del loro valore morfologico nella simmetria florale. Malpighia **19**: 399–439. 1906.

[36] ARMOUR, HELEN M., On the morphology of Chloranthus. New Phytol. **5**: 49–55. *pls. 3–4.* 1906.

knowledge among the more primitive Archichlamydeae. The development of the floral parts and both lines of sporogenesis were studied, the general conclusion being reached that the characters agree with those of the majority of the primitive Archichlamydeae. In the ovule the sporogenous tissue develops as a mass of cells, from which usually a single mother-cell is selected, a late differentiation of that cell which is quite characteristic of gymnosperms. The linear tetrad is formed, but there is the greatest irregularity in the selection of the functioning spore.—J. M. C.

Embryo of Symplocarpus.—C. O. ROSENDAHL[37] has made a preliminary announcement of a remarkable feature of the embryogeny of Symplocarpus. The endosperm destroys both integuments and pushes into the basal tissue of the ovule. There is a short, thick suspensor, and at this end of the "protocorm" both hypocotyl and plumule are differentiated. The developing embryo destroys the endosperm and all of the ovular tissue except at the very base, and thus comes to lie free in the ovary cavity! This means that the "seeds" of Symplocarpus are naked embryos. The full paper, with illustrations, will be looked for with interest.—J. M. C.

Nucleoli in mitosis.—The nucleoli in the vegetative cells of *Equisetum arvense*, according to G. BARGAGLI-PETRUCCI, play an important part in mitosis.[38] In the resting nucleus there is a single centrally placed nucleolus. At the beginning of mitosis, the nucleolus divides, one of the daughter nucleoli passing to each pole of the nucleus, where it perforates the nuclear membrane and passes to the apex of the achromatic figure.

While the figures are doubtless accurate, much more evidence will be required to establish the contention that the nucleoli play such a rôle in mitosis.—CHARLES J. CHAMBERLAIN.

Resistant potatoes.—The selection of races resistant to disease is one of the most promising methods of meeting many kinds of plant diseases. The resistance of Irish potatoes to blight, tuber rot, and scab has been worked out in an admirable way by STEWART.[39] More than one hundred and fifty varieties were tested and their difference in susceptibility is graphically represented. In general, varieties having strong, woody, moderately branched, upright stems, and medium sized, rather thick, firm, hairy leaves were more resistant than varieties possessing weak, much branched, decumbent stems with large, thin, smooth leaves.—F. L. STEVENS.

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[37] ROSENDAHL, C. OTTO, Preliminary note on the embryogeny of *Symplocarpus foetidus* Salisb. Science N. S. **23**: 590. 1906.

[38] BARGAGLI-PETRUCCI, G., I nucleoli durante la cariocinesi nelle cellule meristematiche di *Equisetum arvense*. Nuovo Giorn. Bot. Ital. **12**: 699–708. *pl. 2.* 1905.

[39] STEWART, W., Disease resistance of potatoes. Vermont Agr. Exp. Sta. Bull. 122. 1906.

Glycogen and paraglycogen.—A posthumous paper on this subject by Prof. LÉO ERRERA[40] has been edited from his notes by Dr. J. MASSART. It contains observations on the wide-spread occurrence of one or other of these bodies among the fungi, and their sparse distribution, perhaps only less observed, among the lower plants and animals, and possibly even among sea weeds and seed plants. ERRERA had interested himself in this reserve food for many years and had accumulated a great mass of bibliographical notes on it, which have been reduced to order and herein published.

Epidermal gaps.—Years ago MILDE and KNY and THOMAE described the occurrence of interstitial gaps in the winged bases of the leaves of three Osmundas and a Todea, and similar gaps have been found in the epidermis of floral leaves. Now LEIBLINGER,[41] incidentally, in the course of some cytological studies, finds such gaps in the epidermis of the scales of *Alluim Cepa*, which seem probably connected with the secretion of mucilage.—C. R. B.

Germination of moss spores.—TREBOUX contributes testimony upon the controverted question of the necessity of light for the germination of moss spores.[42] He finds twenty mosses of the most diverse families and three liverworts, a much larger number than has ever been tested before, able to germinate without light and (contrary to HEALD'S results) without cane sugar to replace its stimulating action.—C. R. B.

Haustoria of Osyris.—PIZZONI has published[43] an extended account of the haustoria of *Osyris alba*, supplementing the note of FRAYSSE[44] which unexpectedly forestalled PIZZONI'S paper after all his observations had been completed. He treats of the structure, relations to host, contents, duration, and dimensions of the haustoria.—C. R. B.

Nitrogen for maize.—SOAVE[45] finds that nitrogen supplied to maize in ammonium nitrate does not need to undergo nitrification in order to be available, so that, other things being equal, this compound of nitrogen is to be preferred to sodium nitrate, there being no delay in assimilation as affirmed by GERLACH and VOGEL.—C. R. B.

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[40] ERRERA, L., Glycogène et "paraglycogène" chez les végétaux. Recueil de l'Inst. bot. (Bruxelles) **1**: 343–379. 1905.

[41] LEIBLINGER, G., Ueber interstitienartige Strukturen in der pflanzlichen Epidermis. Ber. Deutsch. Bot. Gesells. **23**: 387–396. *pl. 17*. 1905.

[42] TREBOUX, O., Die Keimung der Moossporen in ihrer Beziehung zum Lichte. Ber. Deutsch. Bot. Gesells. **23**: 397–401. 1905.

[43] PIZZONI, P., Contribuzione alla conoscenza degli austorî dell' *Osyris alba*. Annali di Bot. **4**: 79–98. *pl 3*. 1906.

[44] FRAYSSE, A., Sur la biologie et l'anatomie des suçoirs de l' *Osyris alba*. Compt. Rend. Acad. Sci. Paris **140**: 270–1. 1905.

[45] SOAVE, M., L'azoto ammoniacale e l'azoto nitrico nello sviluppo del mais. Annali di Bot. **4**: 99–114. 1906.

NEWS.

DR. A. F. BLAKESLEE has been appointed recently upon the botanical staff of the Philippine Commission.

PROFESSOR JOHN M. COULTER has been elected an honorary member of the Royal Botanical Society of Edinburgh.

DR. A. B. RENDLE has been appointed Keeper of the Department of Botany in the British Museum (Natural History).

DR. C. F. MILLSPAUGH, Field Columbian Museum, is spending three months in Europe, chiefly in the investigation of museums.

PROFESSOR DR. FRIDIANO CAVARA has been appointed director of the Botanical Garden of Naples in succession to the late Professor DELPINO.

MR. W. R. MAXON, U. S. National Herbarium, has just spent two months in Costa Rica collecting plants for the New York Botanical Garden.

DR. F. ROSEN has been advanced to the position of professor of botany and director of the Institute for Plant Physiology at the University of Breslau.

THE INFORMATION is just published that during 1903 there were 1,352,548 visitors at Kew Gardens; and during 1904 the number increased to 1,579,666.

THE ACADEMY OF SCIENCES in Munich has made a grant of *M*2500 to Dr. Rosz, curator of the Botanical Museum, for zoological and botanical investigation in Central America.

DURING HIS PRESENT VISIT to the United States, Professor HUGO DE VRIES will deliver lectures at the summer session of the University of California and also at the University of Chicago.

AT THE RECENT Franklin Bicentenary at Philadelphia, the University of Pennsylvania conferred the degree of doctor of laws upon Professor HUGO DEVRIES, who was present to deliver an address.

DR. LESTER F. WARD, for twenty-five years the paleobotanist of the United States Geological Survey, has left the ranks of professional botanists by accepting the position of professor of sociology in Brown University.

IN THE RECENT DISASTER at San Francisco the building of the California Academy of Sciences was destroyed, containing the very valuable collection of Californian plants. It is reported that the types were saved by the heroic efforts of Miss ALICE EASTWOOD.

DR. E. N. TRANSEAU, Alma College, Michigan, has been appointed a member of the staff of the Station for Experimental Evolution at Cold Spring Harbor. He will work at evolutionary problems from the ecological side.

MISS FREDA DETMERS, formerly botanist to the Ohio Experiment Station, lately teacher of botany in the Columbus North High School, has been appointed instructor in botany in the Ohio State University and has already assumed the duties of that position.

A BRIEF biography of the late Professor LÉO ERRERA has been distributed, containing, in addition to an appreciative notice of his life and work, a fine likeness in photogravure, and a bibliography numbering 168 titles—a marvelous output, considering its high quality, for a man only 47 years old.

DR. D. S. JOHNSON, Johns Hopkins University, is spending April and May in Jamaica at the Cinchona station of the New York Botanical Garden. Dr. FORREST SHREVE, of the same university, is spending a year at the same station in work on the physiology and ecology of the forest of the Blue Mountains.

DR. VON DER CRONE, assistant in the Botanical Institute of the Royal Agricultural College at Poppelsdorf, near Bonn, returned from a journey in Spain ill with typhus, from which he died on the 23d of February last. He had already published some recent studies on a cause of chlorosis and was prosecuting further work in chemical physiology.

THE EDITOR of *Flora and Sylva*, having issued three volumes in serial form at less than cost, has become convinced that it does not appeal to a sufficient number of readers to justify its continuance as a monthly magazine. Hereafter it is to appear as a yearly volume, but otherwise precisely as heretofore. The next volume will appear in the autumn.

THE MARINE BIOLOGICAL STATION of the University of Washington, which is located at Friday Harbor, Washington, will open for its next season June 25 and will close August 5. The station is supplied with a steamer for transportation and deep dredging and offers good advantages for biological work, together with the pleasures of camping and tramping. Professor BRUCE FINK, Iowa College, will have charge of the botany.

PROFESSOR HUGO DE VRIES opened the course of spring lectures at the New York Botanical Garden on April 21st by an address upon "The correlation of characters in plants." Other lectures in this course will be given by W. A. MURRILL, ARTHUR HOLLICK, L. M. UNDERWOOD, C. S. GAGER, MARSHALL A. HOWE, G. V. NASH, H. H. RUSBY, D. T. MACDOUGAL, and N. L. BRITTON.

INSTRUCTORS in botany at the Biological Laboratory of the Brooklyn Institute located at Cold Spring Harbor, Long Island, for the summer of 1906 are Dr. D. S. JOHNSON, in charge of cryptogamic botany, Dr. E. N. TRANSEAU, in charge of plant ecology, and Mr. H. H. YORK, associate in botany. The laboratory will be open during July and August, the courses beginning July 5, and continuing six weeks.